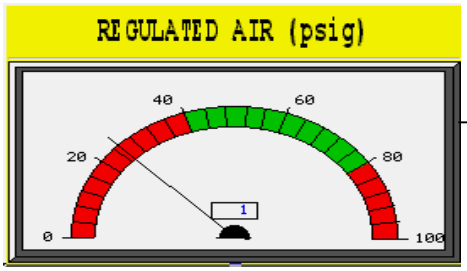
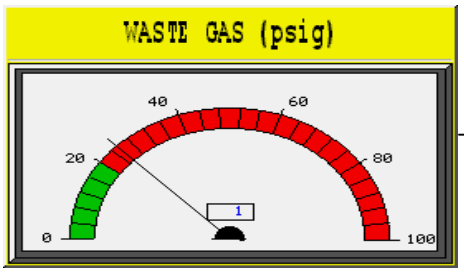
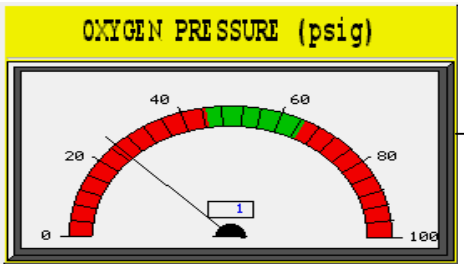
SCREEN 5



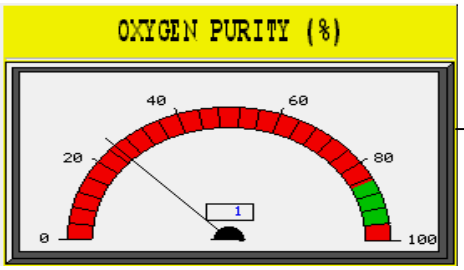
This Meter; REGULATED AIR involves reading your incoming Regulated Air from the compressor. Measurements are in psig, there is both a analog reading and a digital gauge. The digital reading is exact, while the analog meter acts as a real meter. If the dial falls out of the green area an error will appear. The normal operating variance is between 40 and 75 psi.



This Meter; WASTE GAS measures the psig of your Waste Gas. The same details hold true for this gauge as in the REGULATED AIR gauge except for the normal operating variance that is between 0 and 20 psi.



This Meter; OXYGEN PRESSURE measures the Oxygen Pressure (psig) in your back pressure regulator. The same details hold true for this gauge as in the REGULATED AIR gauge except for the normal operating variance which is 45 – 62 psi.

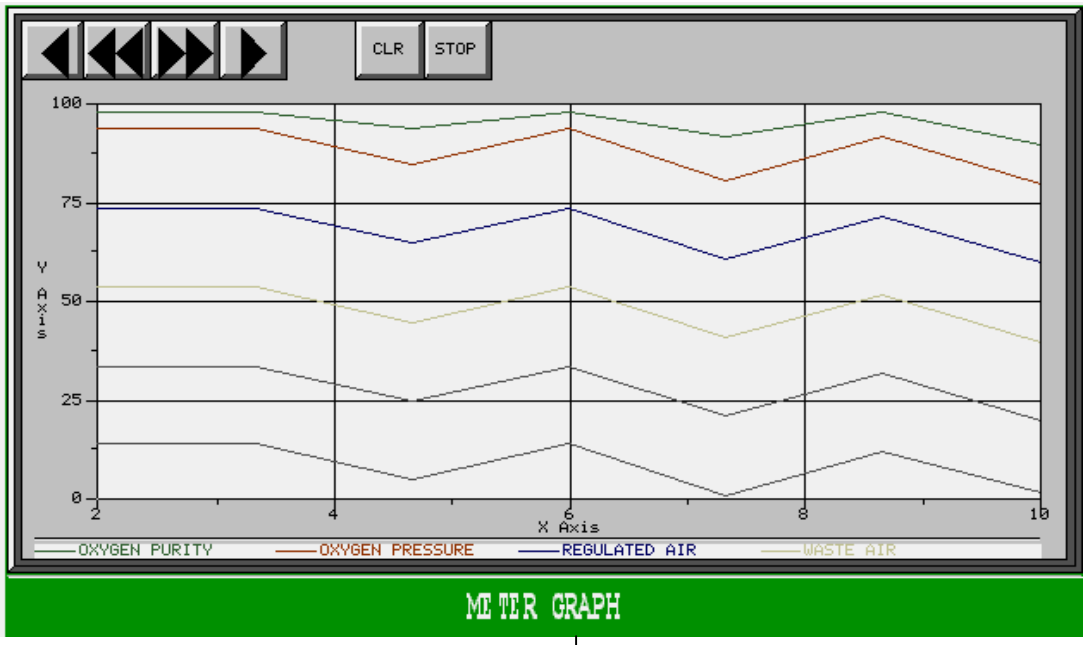


This Meter; OXYGEN PURITY measures the Oxygen Purity that the generator is producing. The same details hold true for this gauge as in the REGULATED AIR gauge except that the Oxygen being generated should be between 85 – 98%.

If you want to go back to the Previous Screen/Main Screen all you have to do is touch the Blue Area.

If you want to advance to the Next Screen/Pressure Screen all you have to do is touch the Blue Area.

SCREEN 6

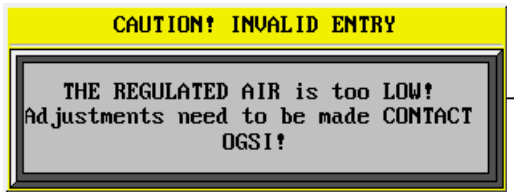


The Line Graph; METER GRAPH displays the activity of the Oxygen Purity, Oxygen Pressure, Waste Gas, and Regulated Air every 5 minutes as long as the generator is on. You can clear the readings, and if the generator is not cycling you can stop the graph from reading. Using the CLR and Stop Buttons. Also you can scroll through the graph using the 4 buttons in the upper left corner.

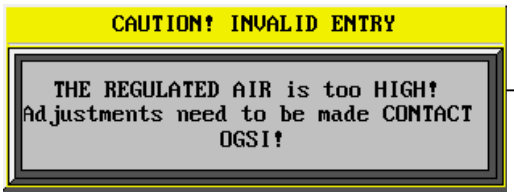
If you want to go back to the Previous Screen/Gauge Screen all you have to do is touch the Blue Area.

If you want to advance to the Next Screen/Alarm Screen all you have to do is touch the Blue Area.

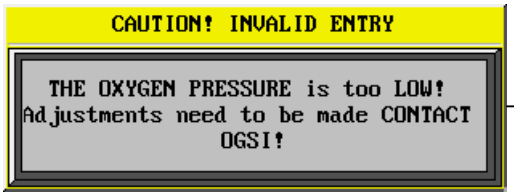
SCREEN 7



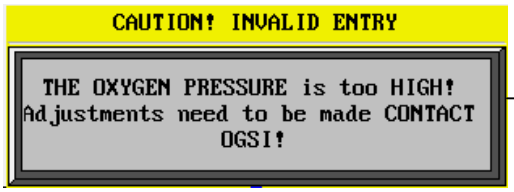
This particular alarm is triggered when the Regulated Air is below 40 psi.



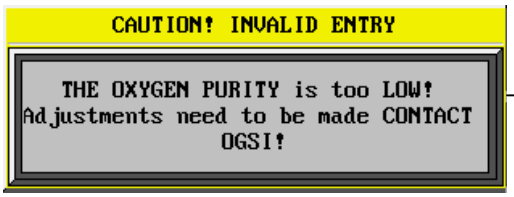
This particular alarm is triggered when the Regulated Air is above 80 psi.



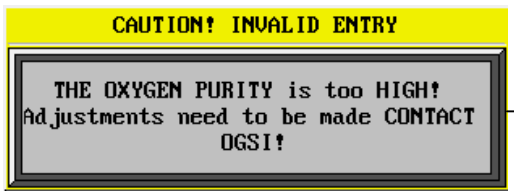
This particular alarm is triggered when the Oxygen Pressure is below 40 psi.



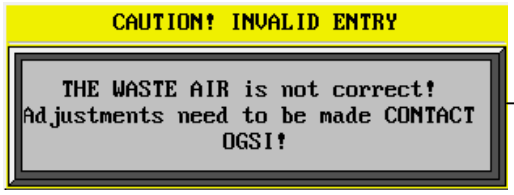
This particular alarm is triggered when the Oxygen Pressure is above 65 psi.



This particular alarm is triggered when the Oxygen Purity is below 85%.



This particular alarm is triggered when the Oxygen Purity is above 96%.



This particular alarm is triggered when the dispersed gas from the muffler is out of the range of 0 – 20 psi

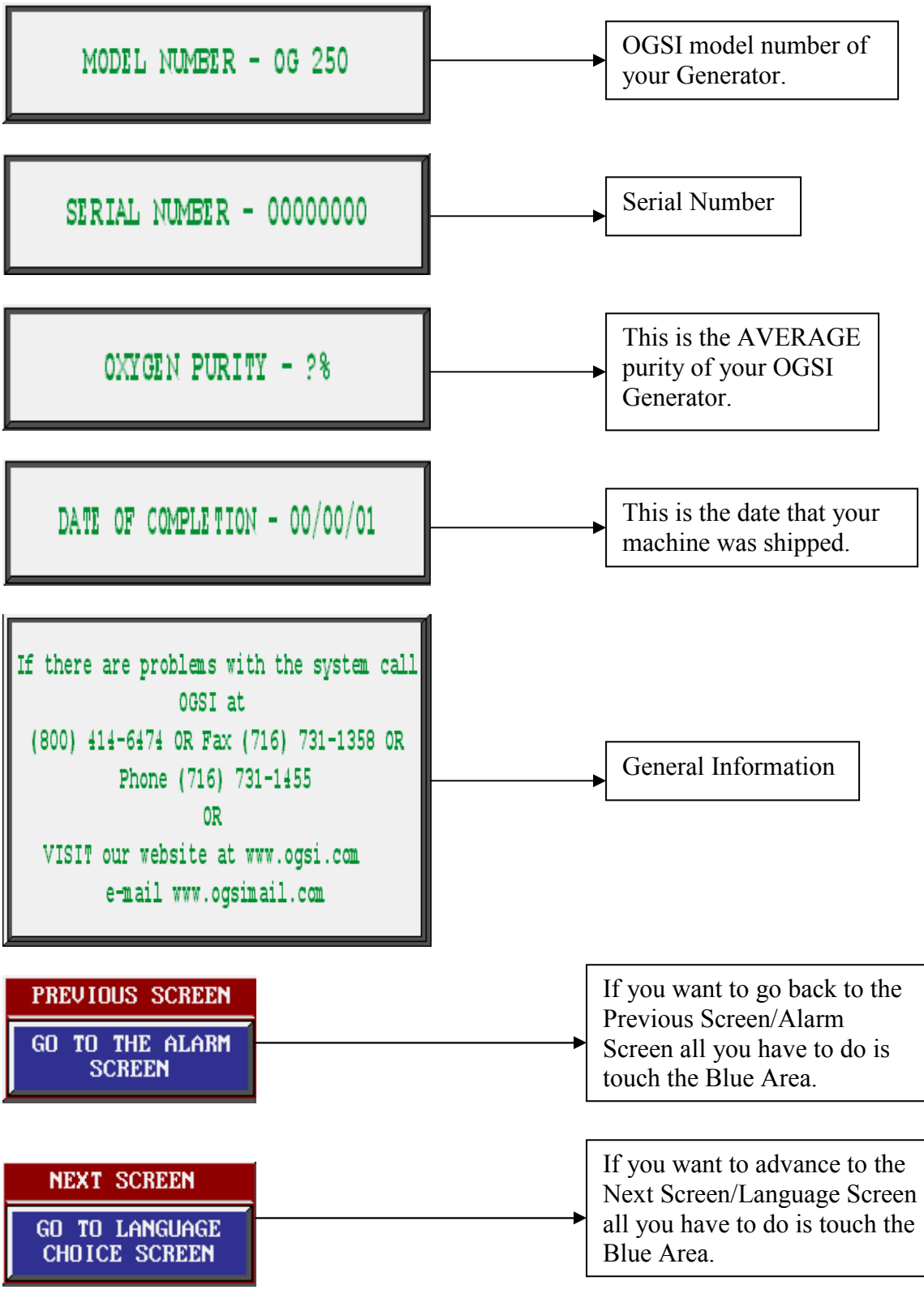
NOTE! These are triggered alarms that will only flash when the machine is cycling. Initially when the generator begins cycling these errors will occur.

This button allows you to look at what caused the errors in the system. This is a database of errors.

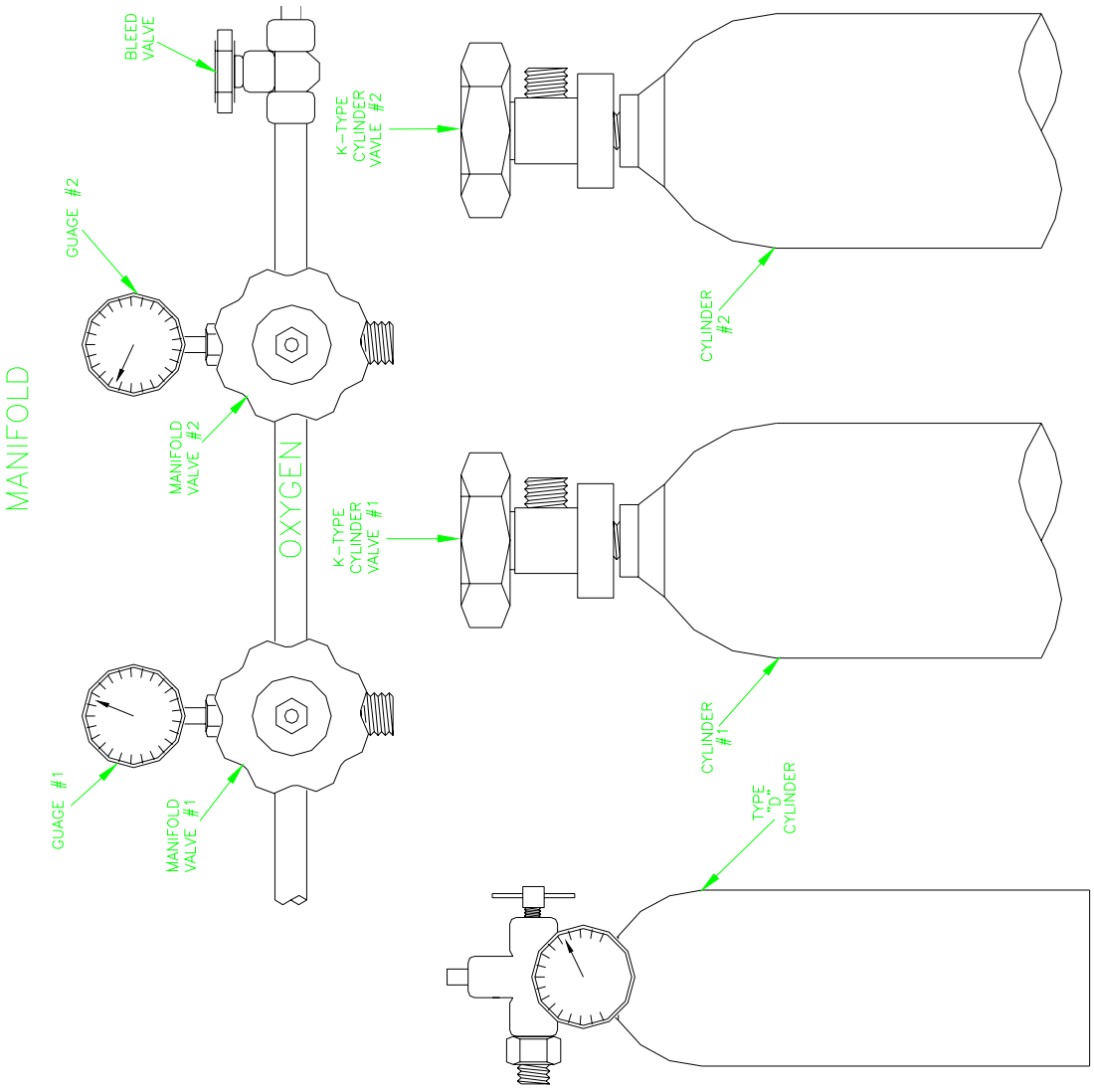
If you want to go back to the Previous Screen/Pressure Screen all you have to do is touch the Blue Area.

If you want to advance to the Next Screen/Final Screen all you have to do is touch the Blue Area.

SCREEN 8


MODEL NUMBER - OG 250
OGSI model number of your Generator.
SERIAL NUMBER - 00000000
Serial Number
OXYGEN PURITY - ?%
This is the AVERAGE purity of your OGSI Generator.
DATE OF COMPLETION - 00/00/01
This is the date that your machine was shipped.
If there are problems with the system call
OGSI at
(800) 414-6474 OR Fax (716) 731-1358 OR
Phone (716) 731-1455
OR
VISIT our website at www.ogsi.com
e-mail www.ogsimail.com
General Information
PREVIOUS SCREEN
GO TO THE ALARM SCREEN
If you want to go back to the Previous Screen/Alarm Screen all you have to do is touch the Blue Area.
NEXT SCREEN
GO TO LANGUAGE CHOICE SCREEN
If you want to advance to the Next Screen/Language Screen all you have to do is touch the Blue Area.

Manifold Drawing



Manifold Operating Procedures

Warning:
High Pressure Oxygen may present a Hazard. Always follow proper operating procedures, and open valves slowly. Rapid pressurization may result in personal injury. Safety glasses and hearing protection are required when venting oxygen under high pressure.

Attaching and filling a K-type cylinder:
With all valves initially closed, connect the steel whip between a manifold valve and a cylinder valve, and tighten both connections using a 1 1/8" wrench. Slowly open the cylinder valve first, and the manifold valve second. Fully open both valves, backing off ¼ turn to prevent the valve from sticking in the open position and appearing closed. At this point, the gauge on the top of the manifold will read the pressure contained within the cylinder. Now, cylinder filling can be initiated by starting the machine, (see start-up procedures).

Detaching a K-type cylinder:
Close each of the appropriate manifold and cylinder valves.

Warning:
Oxygen under high-pressure is present. The use of safety glasses and hearing protection is required. Slowly disconnect the steel whip from the cylinder valve, using a 1 1/8" wrench. Be aware of the venting of oxygen under high pressure. If difficulty is encountered while attempting to remove the steel whip, open the appropriate manifold valve, then slowly open the bleed valve to vent the pressure. This will allow easier removal of the steel whip. Ensure both manifold and bleed valves are closed after venting pressure.

Attaching and filling an M-type cylinder:
It is intended that M-type cylinders be filled from K-type cylinders. With all valves closed, attach the steel whip between the M and K type valves (see Attaching and filling a K-type cylinder outlined above). Slowly open the K-type Cylinder valve, followed by the M-type cylinder valve. Allow pressure to vent from the K-type into the M-type. When the desired pressure is reached in the M-type cylinder, close both valves.

Warning:
Oxygen under high-pressure is present. The use of safety glasses and hearing protection is required. Disconnect the steel whip following the procedure outlined in Detaching a K-type cylinder above.

Routine Maintenance Instructions

Filter Drain:

Make sure the filter drain is working properly and not blocked by anything. When the unit first begins to cycle in the morning the filter drain should open for 5 seconds and then for 5-second periods once every 15 minutes. Do this daily.

Filter Element Replacement:

The filter element provided with the Oxygen Generator must be replaced every six (6) months. The element helps to maintain the quality of the feed air supply and preserve the molecular sieve inside of the oxygen generators. **Failure to replace the filter element on schedule will result in the warranties becoming invalid.**

Cabinet & Power Cord:

The cabinet and power cord should be occasionally washed down with a sponge or clean rag and some soapy water. Avoid the use of ammonia or other strong chemical based cleaning solvents. The intention is to avoid dust and dirt from building up on the machine.

Air Distribution System:

Especially in locations where air is piped over long runs, condensation inside the pipes can be a big problem. The solution is to have traps and drains opened regularly, automatically if practical, to keep the water from reaching your Oxygen Generator

Long Term Maintenance

Air Compressor:

You should consider your air compressor an important part of your Oxygen Generating System and as such maintain it in accordance with the instructions provided in its manual. This will include keeping it properly oiled and changing its filter elements regularly, at a minimum.

The air compressor should last at least two years under normal operating conditions. In many cases it will last five or six years. Eventually, however, it will need to be re-built or replaced. Oxygen purity and flow rate along with feed air pressure delivered to the sieve beds will all be indicators that the air compressor has expended its useful life. Replacement in the field is possible but return of the unit to the factory or an authorized service center is recommended, as by that time a complete maintenance check will be in order.

Valve Replacements:

As with compressor repairs the best practice will be to return the unit to the factory or to an authorized service center for repair.

Filter Element Replacement Instructions

1.) Place the Generator in the 'Continuous' Mode

2.) Close the Valve that Supplies Air to the Generator

3.) Press the Manual Filter Drain Push Button until the Regulated Air Pressure Gauge Reads 0 PSIG

4.) Place the Generator in the 'Off' Mode

5.) Open the Cabinet Door

6.) Disconnect the Plastic Tube from the Brass Prestolok Fitting holding it in Place. This is really the only tricky part in the operation. To disconnect the tube from the fitting the white collar around the tube must be pushed back into the fitting. This releases the tube. It can now be easily pulled out of the fitting. If it is not easy to pull it out of the fitting the collar of the Prestolok fitting is probably not being pushed back into the fitting hard enough. The tube should come out easily once it is released from the fitting.

7.) Remove the Filter Bowls by unscrewing the connecting Allen Head Bolts Holding them together.

8.) Carefully remove them from the Cabinet

9.) Clean out the Inside of the Bowls with Some Soap and Water

10.) Remove the Existing Filter Elements by Unscrewing the Units from the upper threads that are holding them in place

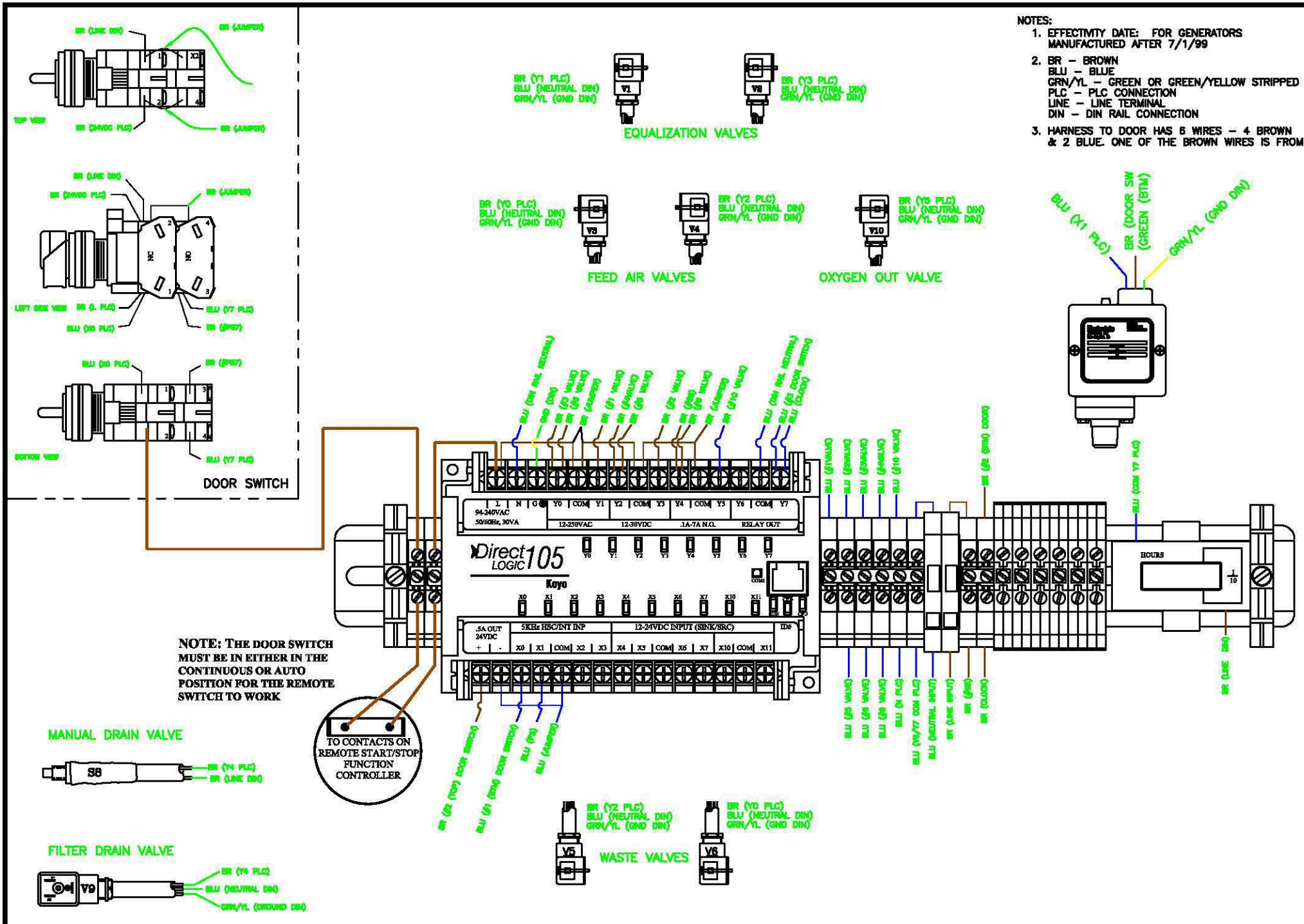
11.) Insert the New Filter Elements

12.) Replace the Filter Bowls

13.) Reconnect the Drain Tubes

14.) Check to see that the Tube Has Been Replaced Securely By Opening the Valve that Supplies Air to the Generator If the tube blows out of the fitting, close the valve again and go back to step 13

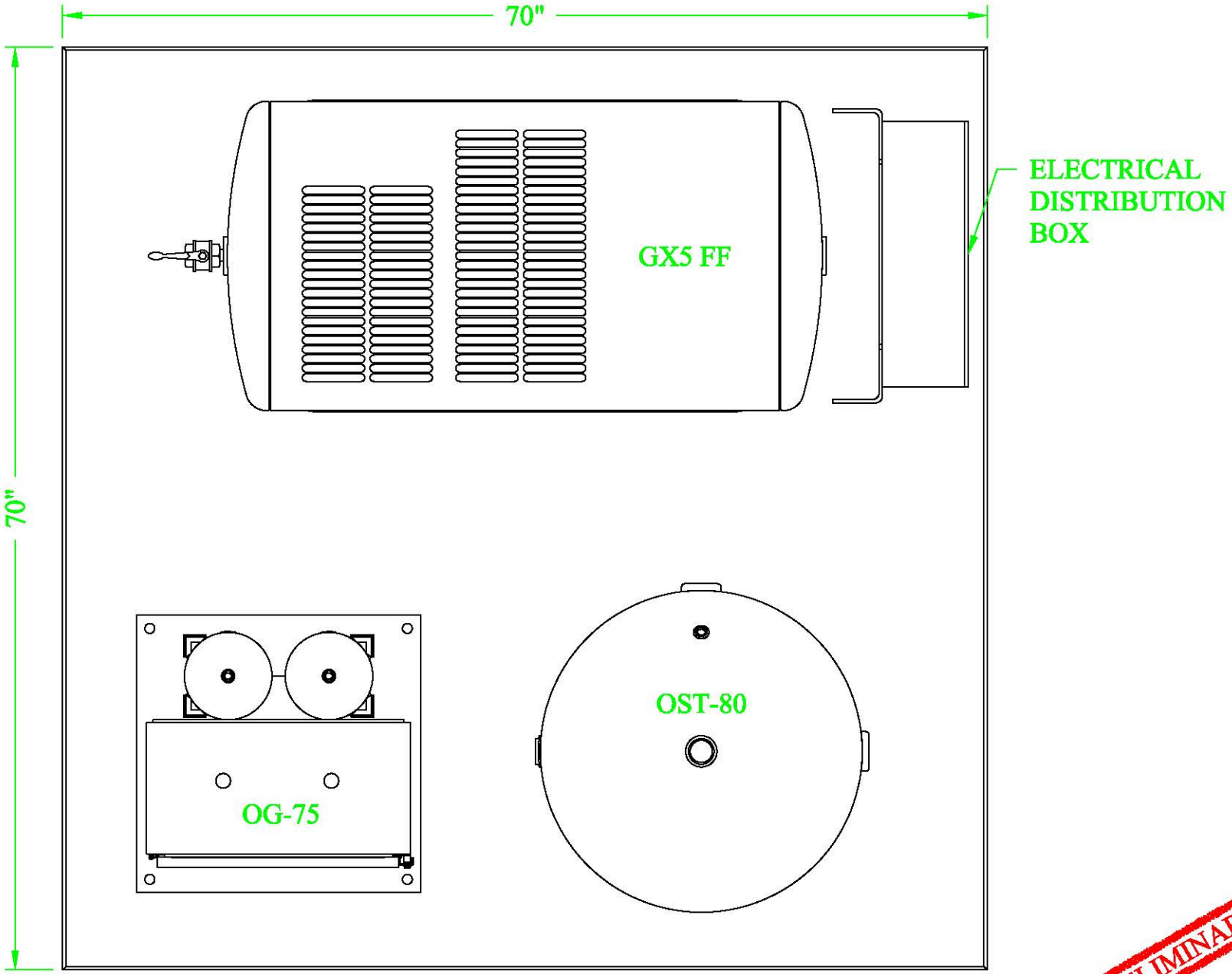
15.) Close the Cabinet Door and Begin Operating, If Desired



REVISIONS				
REV	DESCRIPTION	DATE	CHK	ECN #

OGSI
70 John Glenn Drive
Amherst, New York 14228
Phone: (716) 564-5165
Fax: (716) 564-5173

FILE NAME: DL105 W-REMOTE SWITCH	PLOT SCALE: NTS	EFFECTIVITY OR SERIAL NO.	DRAWN BY: J.C. PALONE	TITLE: WIRING FOR DL 105 WITH REMOTE SWITCH
	ENGINEER: J. M. McMAHON	DATE: 09/20/05	PAGE: 1 OF 1	



PRELIMINARY

REVISIONS				
REV	DESCRIPTION	DATE	CHK	ECN #

OGSI
70 John Glenn Drive
Amherst, New York 14226
Phone: (716) 564-5165
Fax: (716) 564-5173

FILE NAME	PLOT SCALE	EFFECTIVITY OR SERIAL NO.	DRAWN BY
PPT OG-75 EQUIP LAYOUT	NTS		J.C. PALONE
ENGINEER	DATE		PAGE
J. M. McMAHON	08/01/05		1 OF 1

TITLE
EQUIPMENT LAYOUT
PIERSON PROCESS TECH

INNOVATION INSIDE

NEW CR 1, 3, and 5

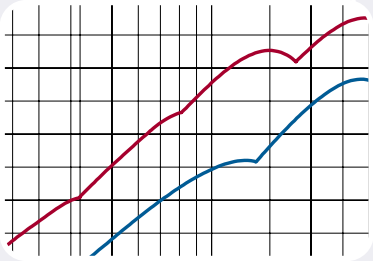
We've redesigned our CR line for increased economy and performance

Grundfos is known for our strong commitment to research and cutting-edge technology. To that end, we've redesigned our multistage CR pumps. The CR has long been the industry standard for reliability and economy. Even so, important improvements come from talking with the people who work with our pumps every day. We've replaced the CR/CRN 2 and 4 with four pump sizes ideally suited to your applications: CR1s, 1, 3, and 5, all in material versions CR/CRI/CRN. New features you'll appreciate:

A hard-wearing, easy-to-replace cartridge seal minimizes downtime

Superior reliability with added protection against dry-running

More standard connections, including threaded and flanged, plus customized connections.



Unmatched operating economy from state-of-the-art pump efficiency

New sizes

We've heard that 15% of CR2 pumps are used for flows under 5 gpm, so we've designed the CR1s with an optimal duty point of 4 gpm.

The new narrower interval between pump sizes and wider range results in a better match with pump capacity, motor size, and system requirements. This cuts investment and operating costs.

New sizes, features, and the available materials provide thousands of possible configurations to ensure you get the right pump for the job.

Connections

We offer additional standard connections, including threaded and flanged, plus victaulic, clamp, and union. Customized connections are available.

Dimensions

Connection dimensions haven't changed and are 100% interchangeable. However, improvements resulted in minor changes in pump height, which could affect your system. We're ready to assist you in the transition to the new CR line.

Conversion software

We've enclosed a CD-ROM with software to help you select the CR that matches your requirements. You can compare the performance and dimensions of the new CR line with those of the CR/CRN 2 and 4. The CD-ROM provides downloadable CAD drawings.

Superior reliability

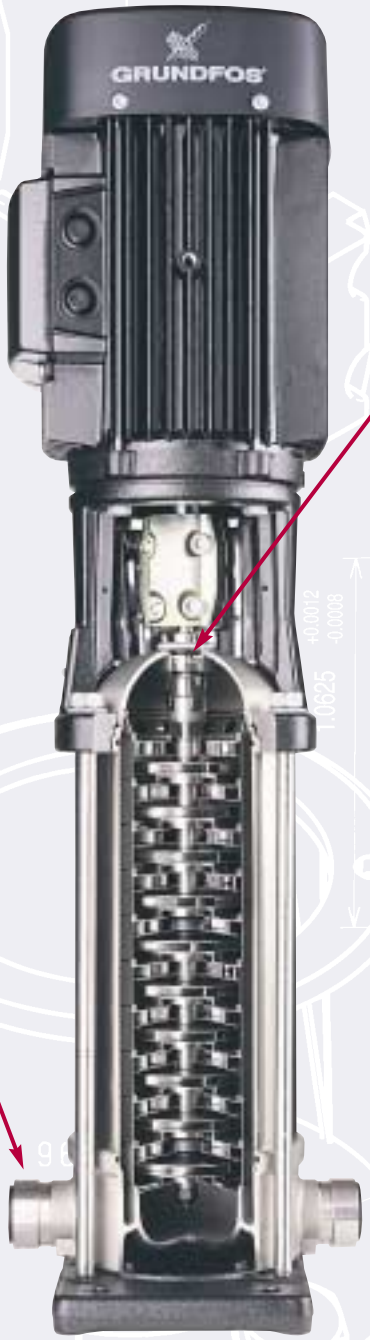
Dry-running is the most common cause of pump failure. The new Grundfos LiqTec™ pump accessory shuts the pump down the instant it runs dry. Plus, we've improved pump components to better withstand brief periods of dry-running.

Connection options

A broad range of connections match any system requirement.

Oval flange

Flexiclamp



New cartridge seal increases reliability and allows easier access

Hard-wearing materials prolong the life of the seal and minimize downtime for your system. Seal components are combined into a single cartridge unit for fast replacement when the seal finally wears out.

With the cartridge seal, there's no risk of assembling seal components incorrectly. Plus, the seal surfaces are protected against impurities.

Unmatched operating economy

85% of the cost of owning and operating a pump is for the electricity to run it. Redesigning our CR pumps resulted in a 10% increase in efficiency and a resulting decrease in power consumption costs.

Everything you need is in this brochure:

Performance curves

We've included performance curves for each of the new pumps compared with the CR/CRN 2 and 4. See the following pages for:

CR/CRI/CRN 50 and 60 Hz

CR 2 / CR 1s

CR 2 / CR 1

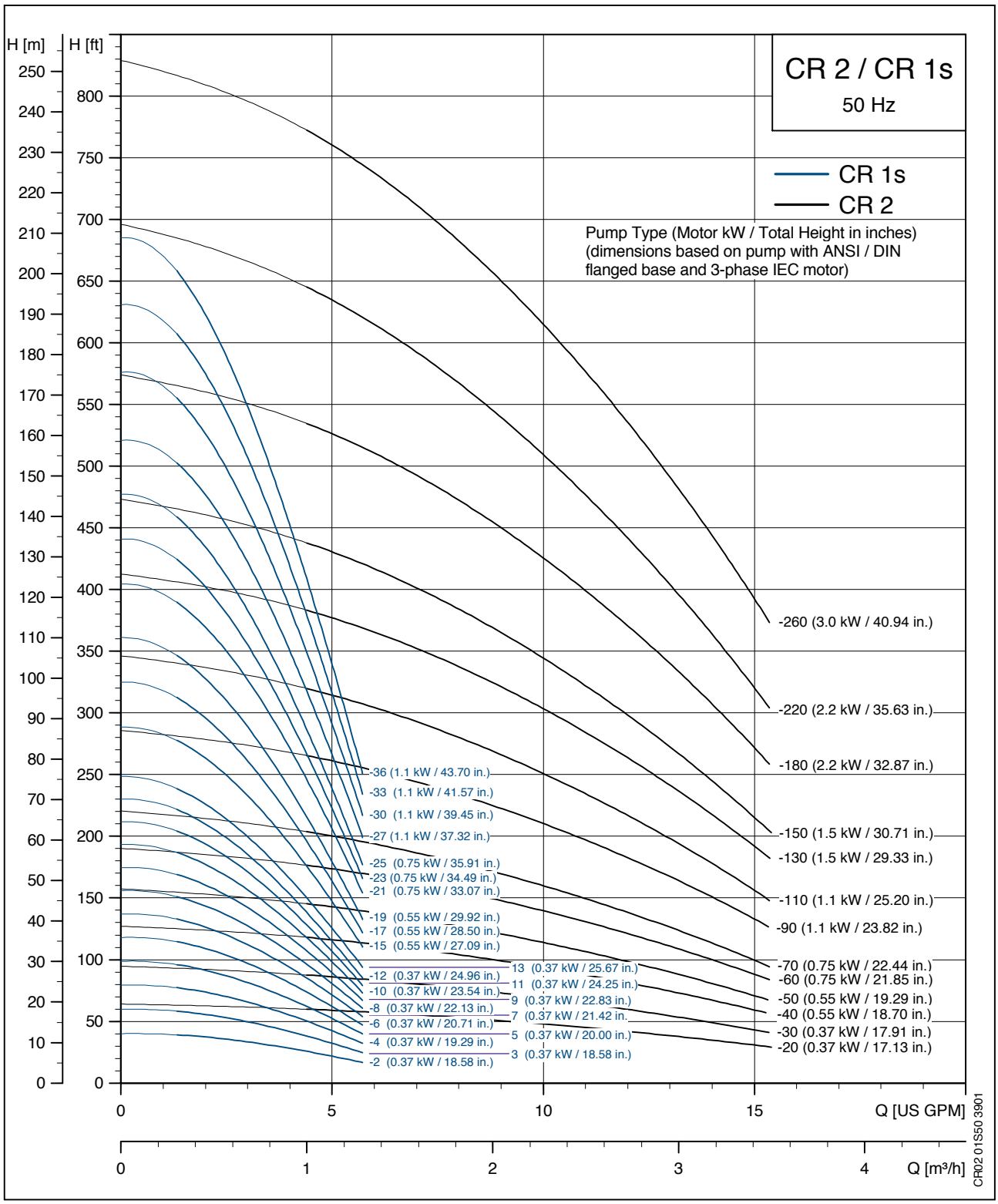
CR 2 / CR 3

CR 4 / CR 3

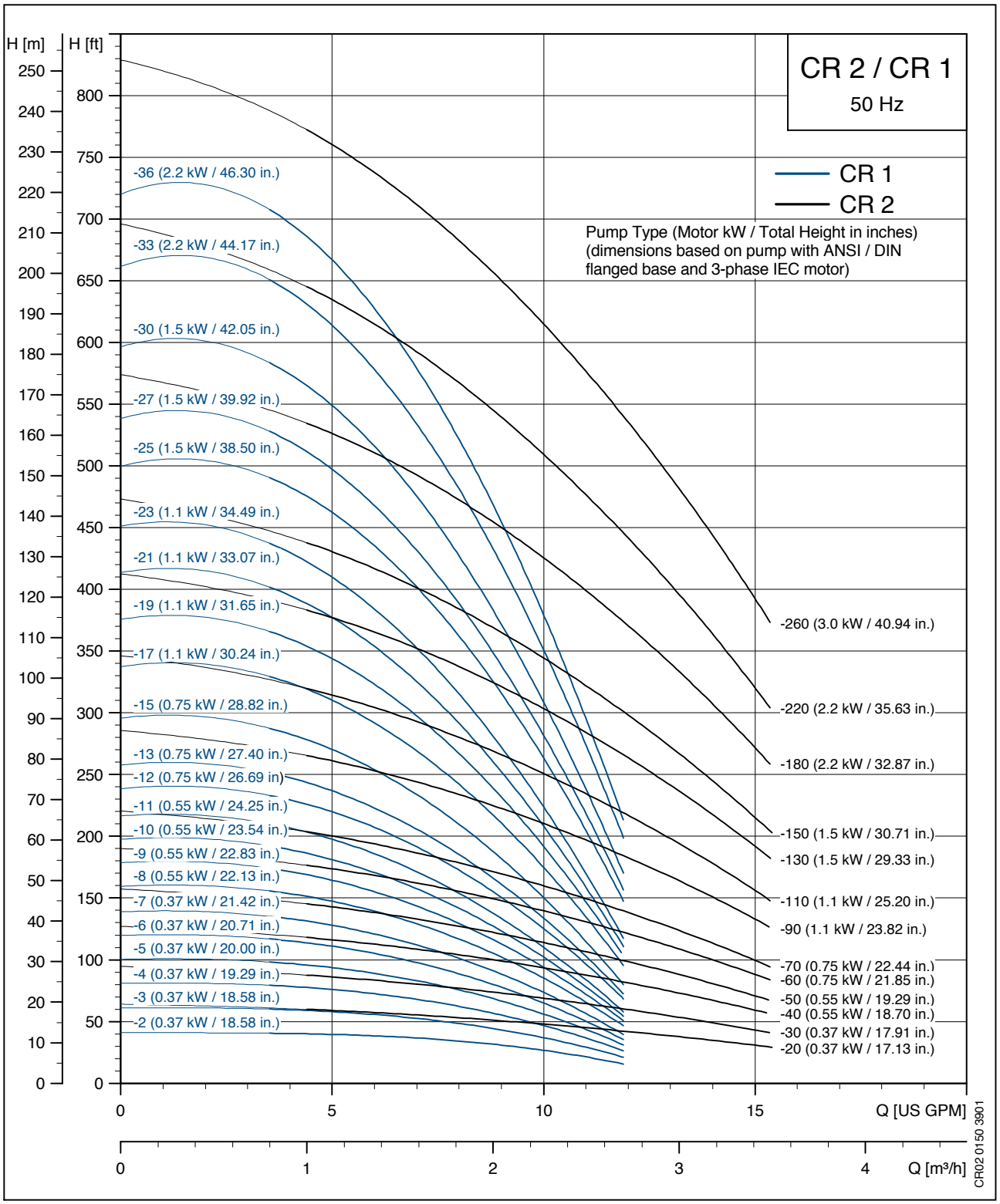
CR 4 / CR 5

Pump conversion software

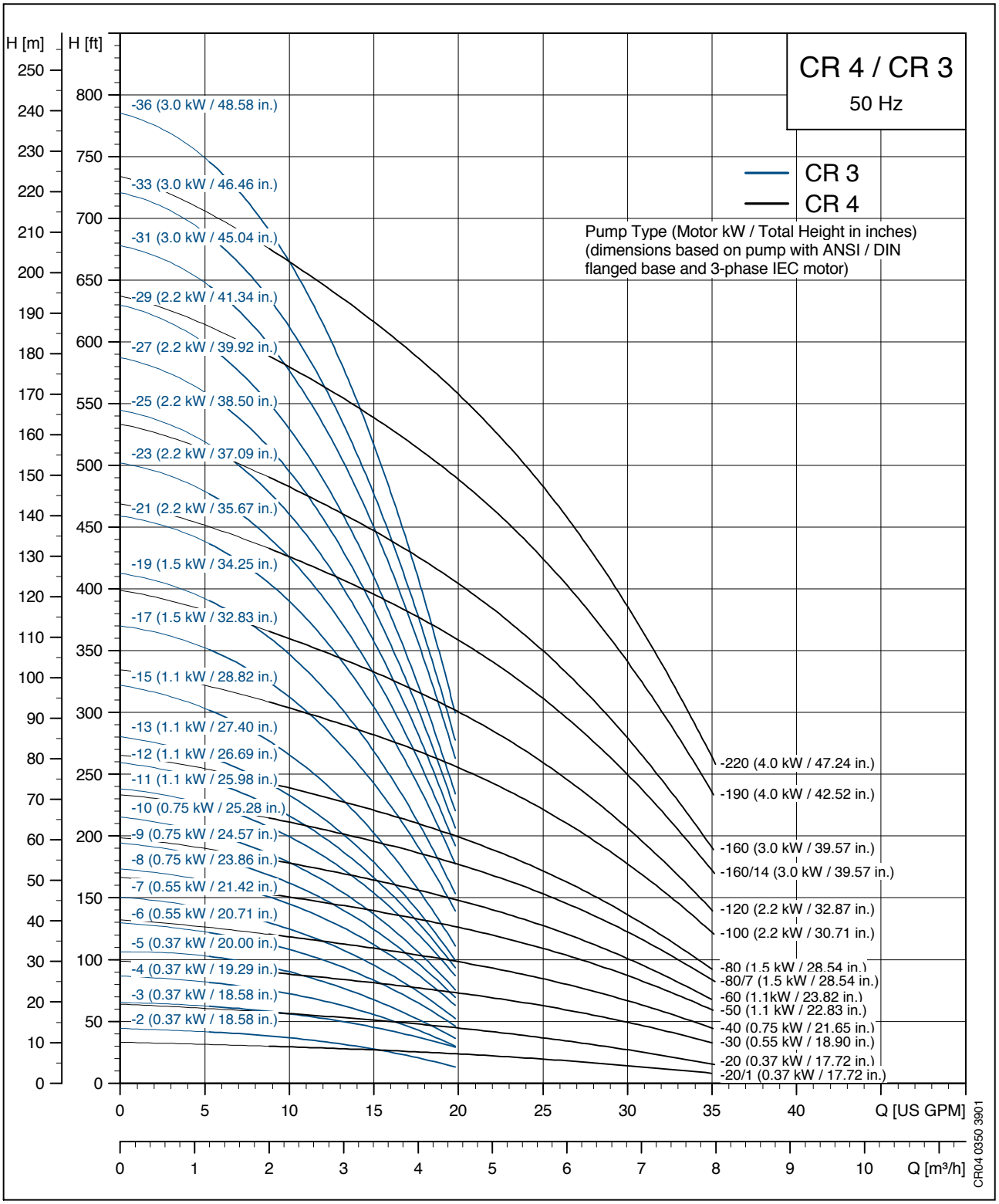
Inside back cover holds a downloadable CD with details on the redesigned CR line.

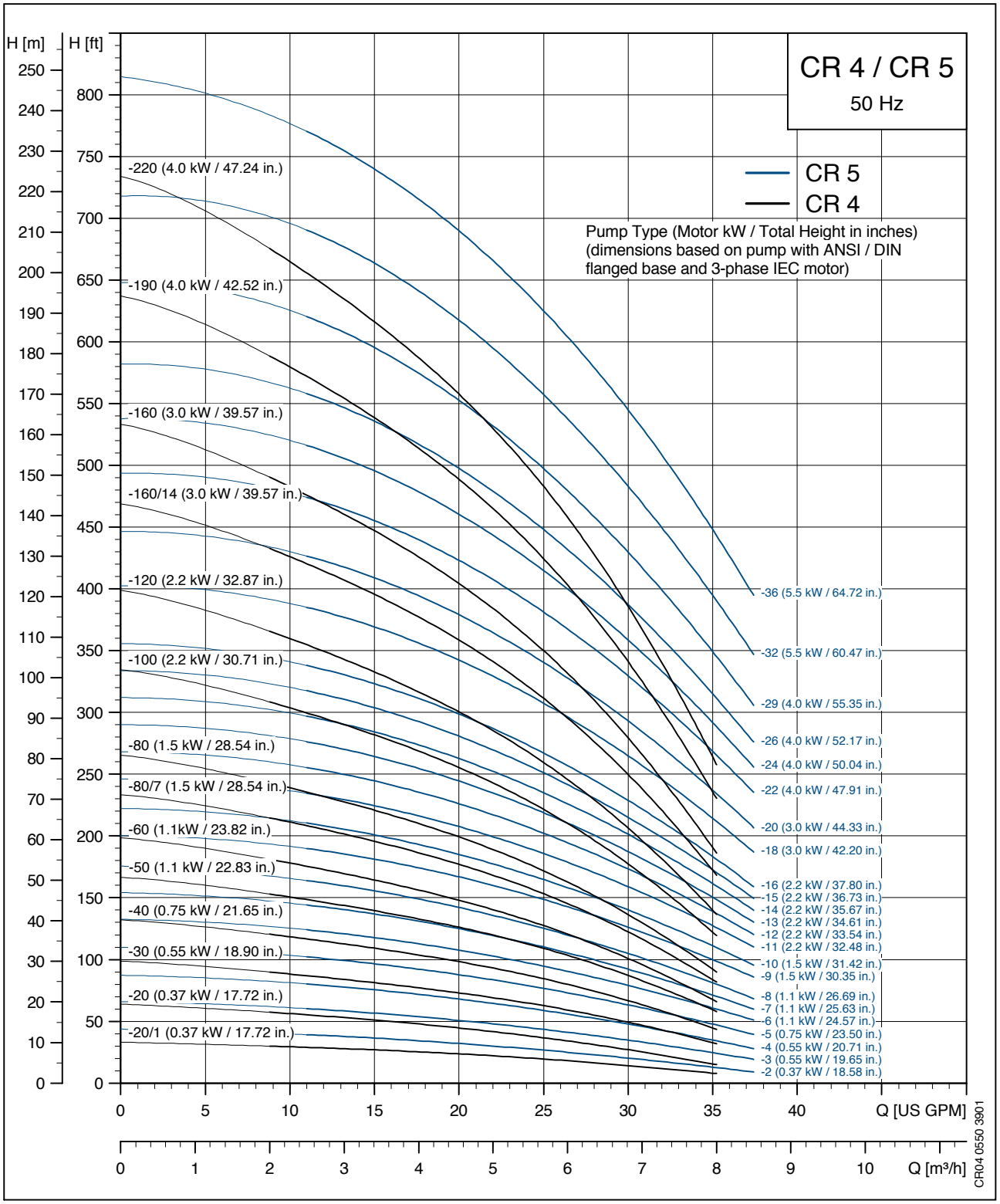

CR 2 / CR 1s
50 Hz
CR 1s
CR 2
Pump Type (Motor kW / Total Height in inches)
(dimensions based on pump with ANSI / DIN
flanged base and 3-phase IEC motor)
H [m]
H [ft]
Q [US GPM]
Q [m³/h]
CR02 01S50 3901
-260 (3.0 kW / 40.94 in.)
-220 (2.2 kW / 35.63 in.)
-180 (2.2 kW / 32.87 in.)
-150 (1.5 kW / 30.71 in.)
-130 (1.5 kW / 29.33 in.)
-110 (1.1 kW / 25.20 in.)
-90 (1.1 kW / 23.82 in.)
-70 (0.75 kW / 22.44 in.)
-60 (0.75 kW / 21.85 in.)
-50 (0.55 kW / 19.29 in.)
-40 (0.55 kW / 18.70 in.)
-30 (0.37 kW / 17.91 in.)
-20 (0.37 kW / 17.13 in.)
-36 (1.1 kW / 43.70 in.)
-33 (1.1 kW / 41.57 in.)
-30 (1.1 kW / 39.45 in.)
-27 (1.1 kW / 37.32 in.)
-25 (0.75 kW / 35.91 in.)
-23 (0.75 kW / 34.49 in.)
-21 (0.75 kW / 33.07 in.)
-19 (0.55 kW / 29.92 in.)
-17 (0.55 kW / 28.50 in.)
-15 (0.55 kW / 27.09 in.)
13 (0.37 kW / 25.67 in.)
-12 (0.37 kW / 24.96 in.)
11 (0.37 kW / 24.25 in.)
-10 (0.37 kW / 23.54 in.)
9 (0.37 kW / 22.83 in.)
-8 (0.37 kW / 22.13 in.)
7 (0.37 kW / 21.42 in.)
-6 (0.37 kW / 20.71 in.)
5 (0.37 kW / 20.00 in.)
-4 (0.37 kW / 19.29 in.)
3 (0.37 kW / 18.58 in.)
-2 (0.37 kW / 18.58 in.)

PERFORMANCE **CR 2/CR 1 50 Hz**

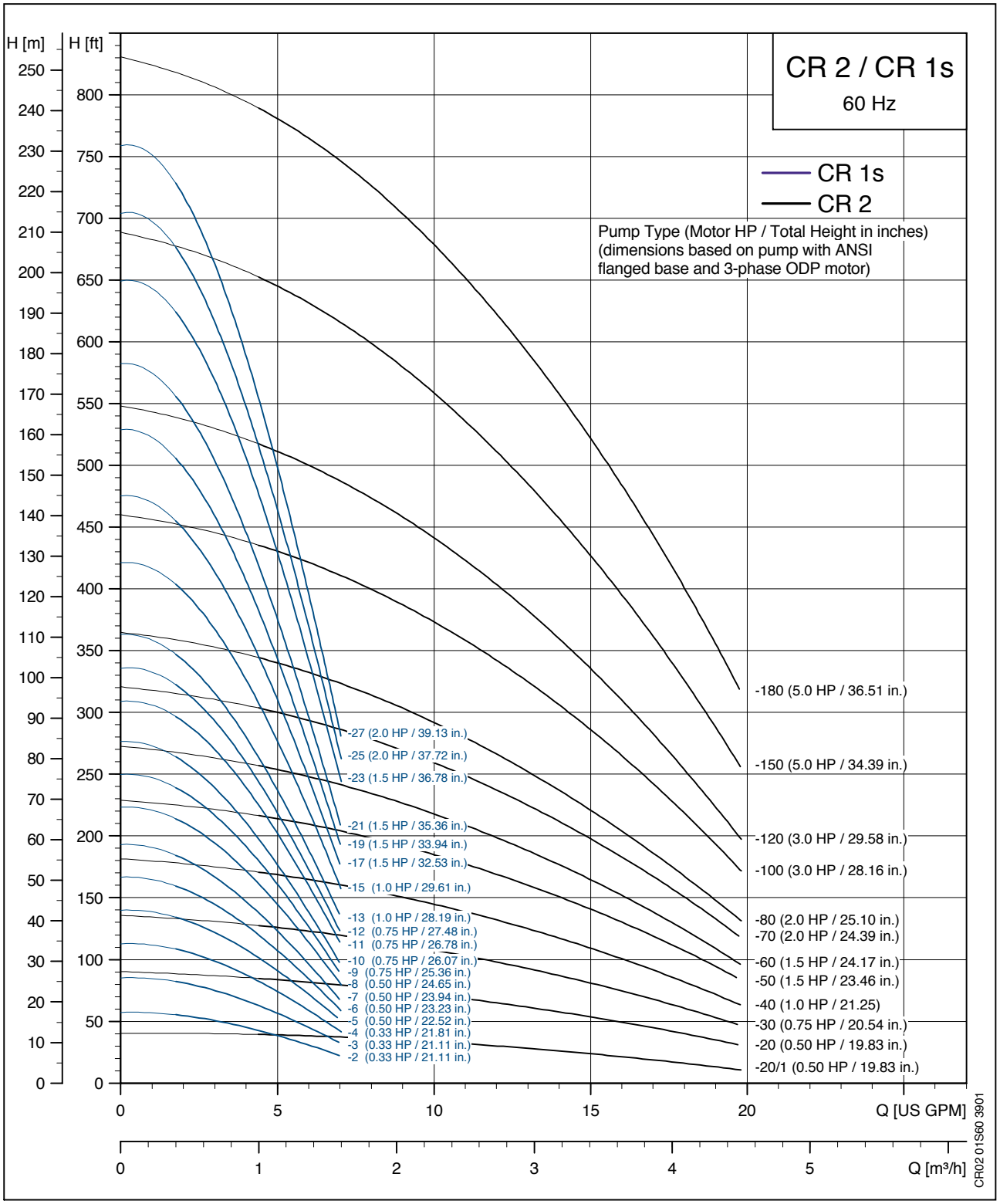


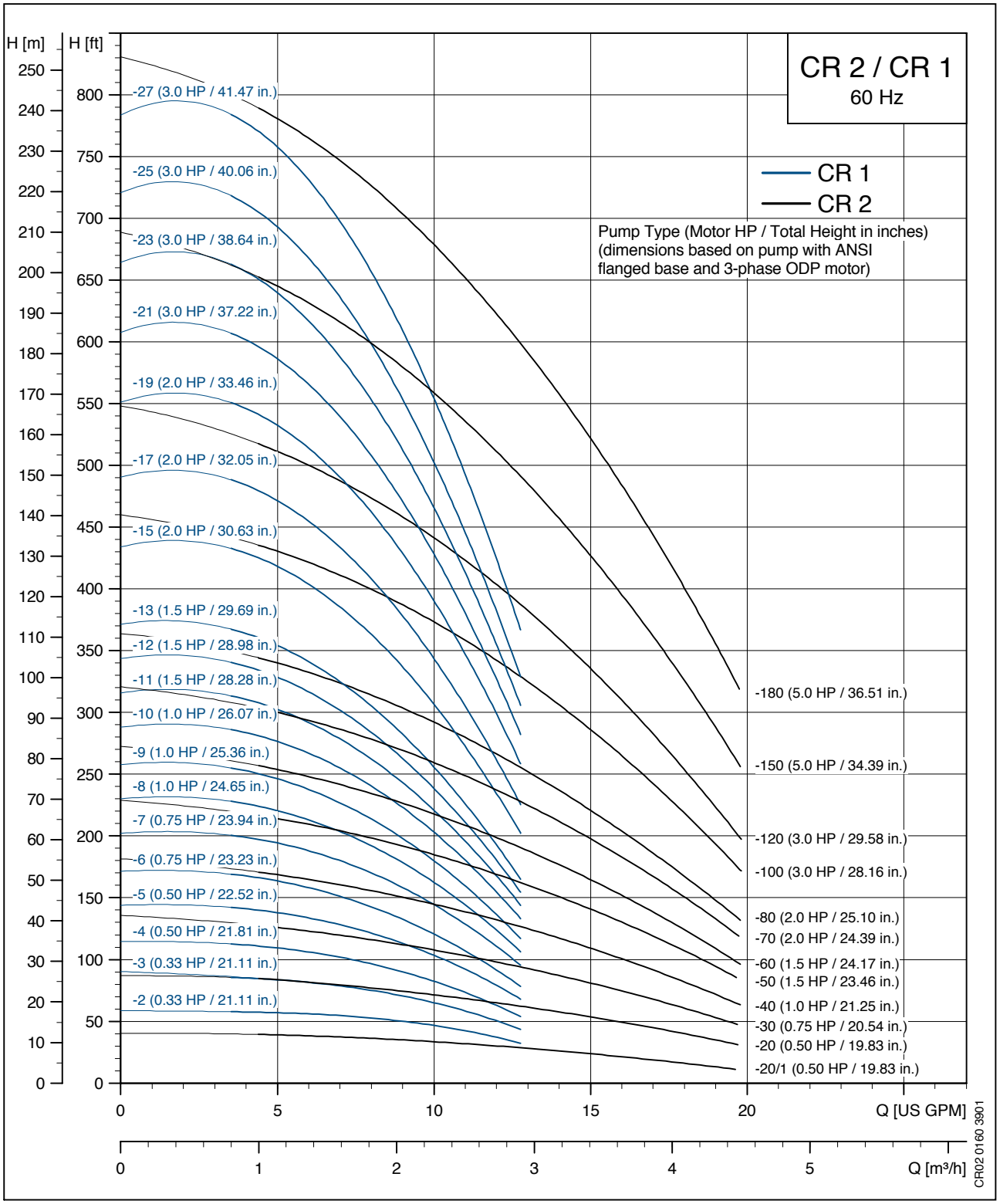
PERFORMANCE **CR 4/CR 3 50 Hz**



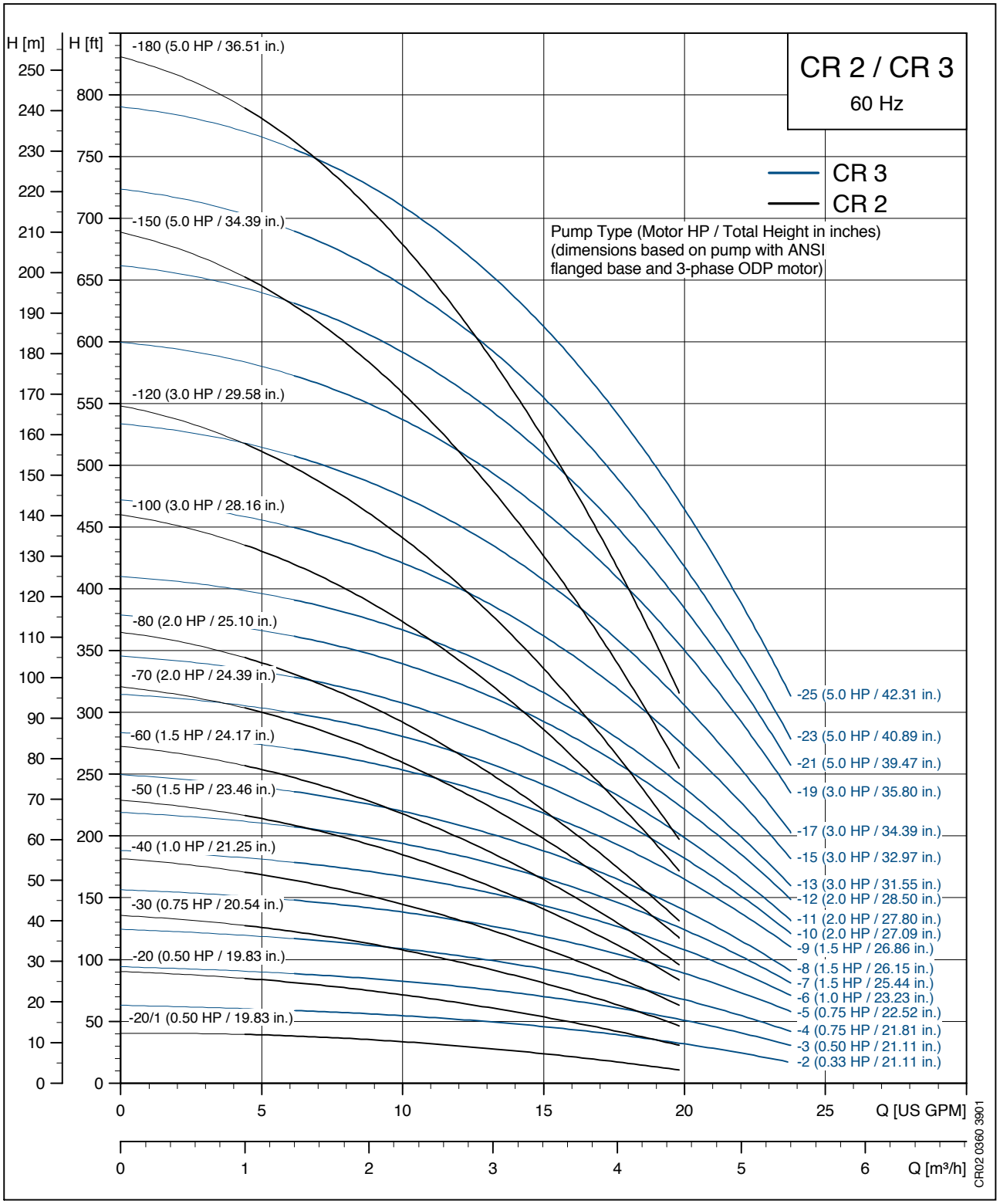

CR 4 / CR 5
50 Hz
CR 5
CR 4
Pump Type (Motor kW / Total Height in inches)
(dimensions based on pump with ANSI / DIN
flanged base and 3-phase IEC motor)
H [m]
H [ft]
-220 (4.0 kW / 47.24 in.)
-190 (4.0 kW / 42.52 in.)
-160 (3.0 kW / 39.57 in.)
-160/14 (3.0 kW / 39.57 in.)
-120 (2.2 kW / 32.87 in.)
-100 (2.2 kW / 30.71 in.)
-80 (1.5 kW / 28.54 in.)
-80/7 (1.5 kW / 28.54 in.)
-60 (1.1kW / 23.82 in.)
-50 (1.1 kW / 22.83 in.)
-40 (0.75 kW / 21.65 in.)
-30 (0.55 kW / 18.90 in.)
-20 (0.37 kW / 17.72 in.)
-20/1 (0.37 kW / 17.72 in.)
-36 (5.5 kW / 64.72 in.)
-32 (5.5 kW / 60.47 in.)
-29 (4.0 kW / 55.35 in.)
-26 (4.0 kW / 52.17 in.)
-24 (4.0 kW / 50.04 in.)
-22 (4.0 kW / 47.91 in.)
-20 (3.0 kW / 44.33 in.)
-18 (3.0 kW / 42.20 in.)
-16 (2.2 kW / 37.80 in.)
-15 (2.2 kW / 36.73 in.)
-14 (2.2 kW / 35.67 in.)
-13 (2.2 kW / 34.61 in.)
-12 (2.2 kW / 33.54 in.)
-11 (2.2 kW / 32.48 in.)
-10 (1.5 kW / 31.42 in.)
-9 (1.5 kW / 30.35 in.)
-8 (1.1 kW / 26.69 in.)
-7 (1.1 kW / 25.63 in.)
-6 (1.1 kW / 24.57 in.)
-5 (0.75 kW / 23.50 in.)
-4 (0.55 kW / 20.71 in.)
-3 (0.55 kW / 19.65 in.)
-2 (0.37 kW / 18.58 in.)
Q [US GPM]
Q [m³/h]
CR04 0550 3901

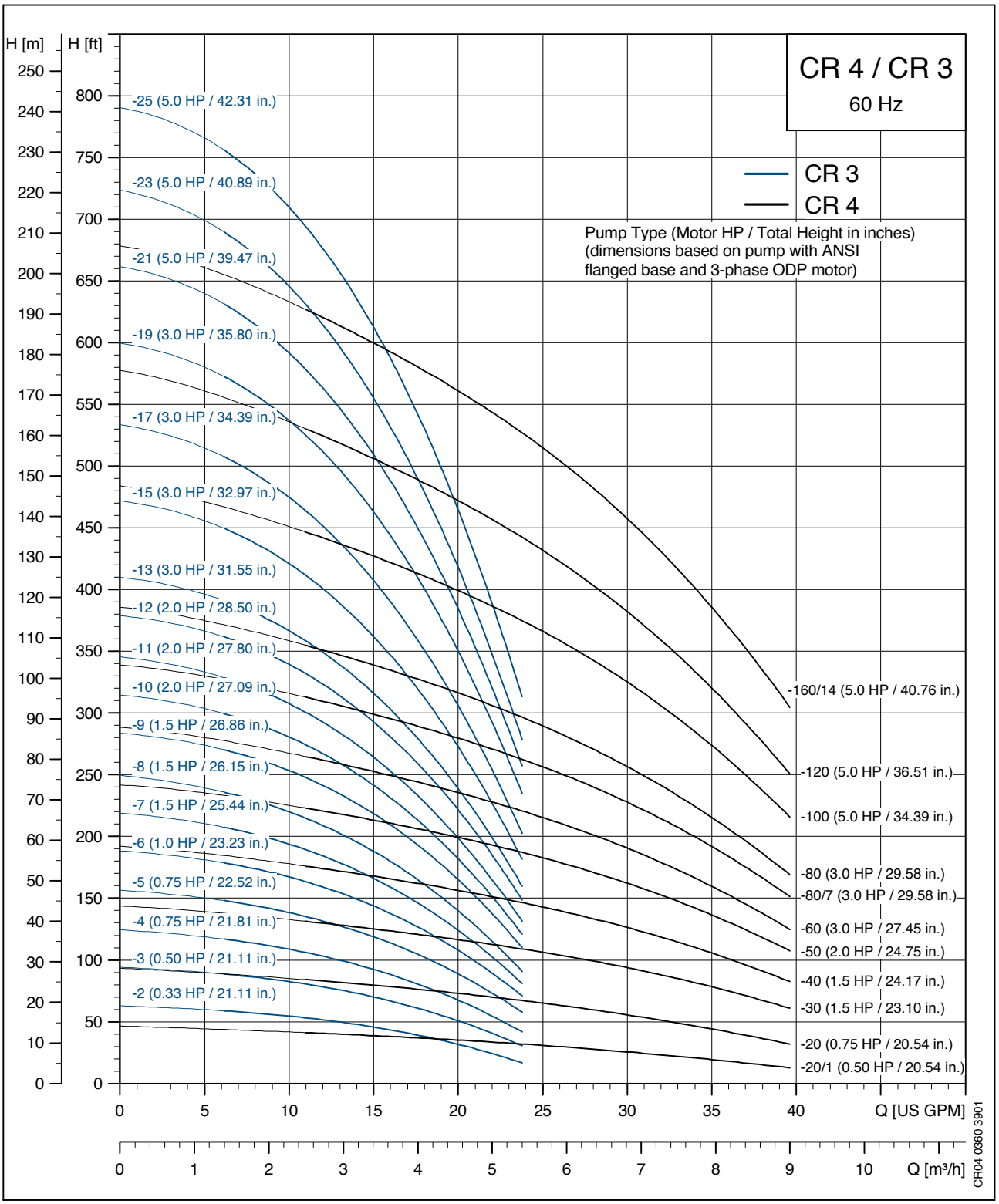
PERFORMANCE **CR 2/CR 1 s 60 Hz**



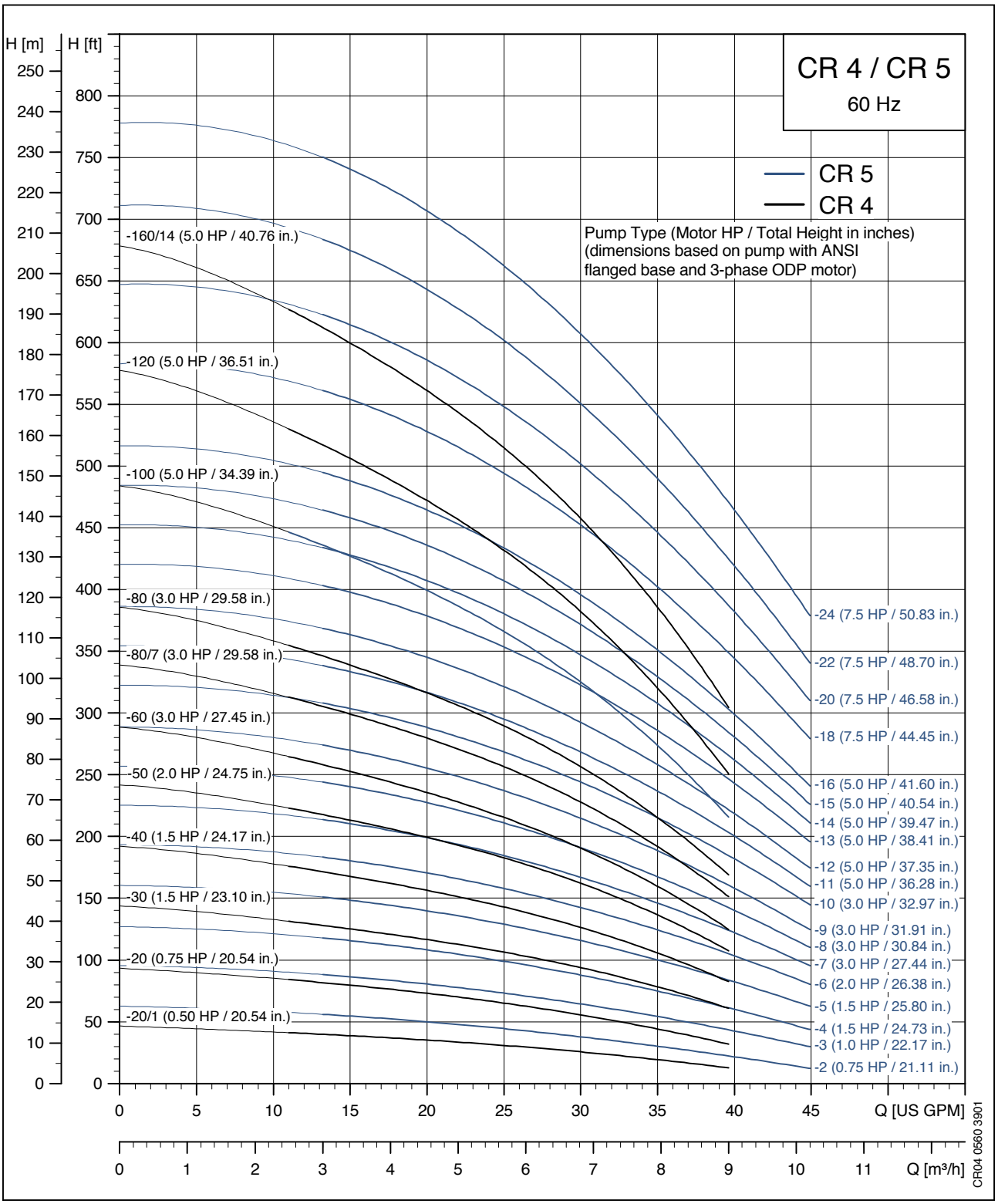

CR 2 / CR 1
60 Hz
CR 1
CR 2
Pump Type (Motor HP / Total Height in inches)
(dimensions based on pump with ANSI
flanged base and 3-phase ODP motor)
H [m]
H [ft]
-27 (3.0 HP / 41.47 in.)
-25 (3.0 HP / 40.06 in.)
-23 (3.0 HP / 38.64 in.)
-21 (3.0 HP / 37.22 in.)
-19 (2.0 HP / 33.46 in.)
-17 (2.0 HP / 32.05 in.)
-15 (2.0 HP / 30.63 in.)
-13 (1.5 HP / 29.69 in.)
-12 (1.5 HP / 28.98 in.)
-11 (1.5 HP / 28.28 in.)
-10 (1.0 HP / 26.07 in.)
-9 (1.0 HP / 25.36 in.)
-8 (1.0 HP / 24.65 in.)
-7 (0.75 HP / 23.94 in.)
-6 (0.75 HP / 23.23 in.)
-5 (0.50 HP / 22.52 in.)
-4 (0.50 HP / 21.81 in.)
-3 (0.33 HP / 21.11 in.)
-2 (0.33 HP / 21.11 in.)
-180 (5.0 HP / 36.51 in.)
-150 (5.0 HP / 34.39 in.)
-120 (3.0 HP / 29.58 in.)
-100 (3.0 HP / 28.16 in.)
-80 (2.0 HP / 25.10 in.)
-70 (2.0 HP / 24.39 in.)
-60 (1.5 HP / 24.17 in.)
-50 (1.5 HP / 23.46 in.)
-40 (1.0 HP / 21.25 in.)
-30 (0.75 HP / 20.54 in.)
-20 (0.50 HP / 19.83 in.)
-20/1 (0.50 HP / 19.83 in.)
Q [US GPM]
Q [m³/h]
CR02 0160 3901

PERFORMANCE **CR 2/CR 3 60 Hz**




CR 4 / CR 3
60 Hz
CR 3
CR 4
Pump Type (Motor HP / Total Height in inches)
(dimensions based on pump with ANSI
flanged base and 3-phase ODP motor)
H [m]
H [ft]
-25 (5.0 HP / 42.31 in.)
-23 (5.0 HP / 40.89 in.)
-21 (5.0 HP / 39.47 in.)
-19 (3.0 HP / 35.80 in.)
-17 (3.0 HP / 34.39 in.)
-15 (3.0 HP / 32.97 in.)
-13 (3.0 HP / 31.55 in.)
-12 (2.0 HP / 28.50 in.)
-11 (2.0 HP / 27.80 in.)
-10 (2.0 HP / 27.09 in.)
-9 (1.5 HP / 26.86 in.)
-8 (1.5 HP / 26.15 in.)
-7 (1.5 HP / 25.44 in.)
-6 (1.0 HP / 23.23 in.)
-5 (0.75 HP / 22.52 in.)
-4 (0.75 HP / 21.81 in.)
-3 (0.50 HP / 21.11 in.)
-2 (0.33 HP / 21.11 in.)
-160/14 (5.0 HP / 40.76 in.)
-120 (5.0 HP / 36.51 in.)
-100 (5.0 HP / 34.39 in.)
-80 (3.0 HP / 29.58 in.)
-80/7 (3.0 HP / 29.58 in.)
-60 (3.0 HP / 27.45 in.)
-50 (2.0 HP / 24.75 in.)
-40 (1.5 HP / 24.17 in.)
-30 (1.5 HP / 23.10 in.)
-20 (0.75 HP / 20.54 in.)
-20/1 (0.50 HP / 20.54 in.)
Q [US GPM]
Q [m³/h]
CR04 0360 3901

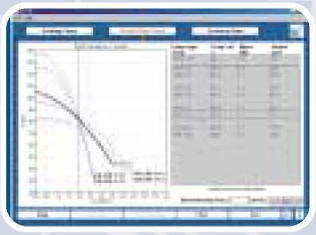
PERFORMANCE **CR 4/CR 5 60 Hz**



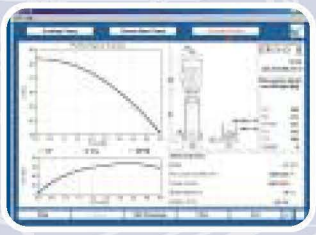
Pump conversion software

Load the CD-ROM onto your computer and follow the instructions that appear on your screen. Within seconds you will have details on the redesigned CR line.

Enter the pump type, flow and connection type of your existing CR. Click “Choose new pump.”



Consult the performance curves and select the new CR which best matches your needs from the list. Click “Technical Data.”



Technical data and exportable CAD drawings are presented here.

BE > THINK > INNOVATE >

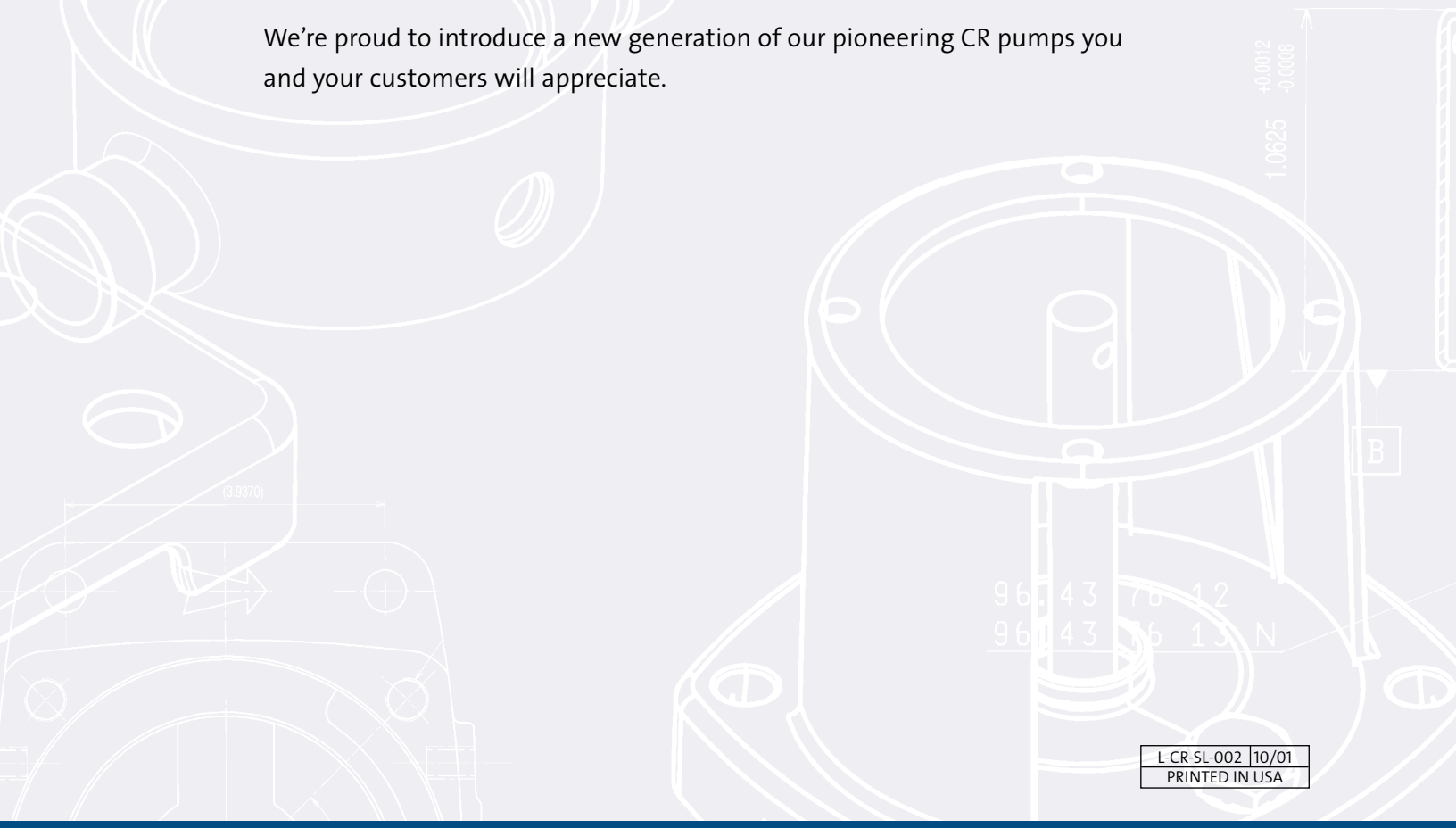
BEING RESPONSIBLE IS OUR FOUNDATION
THINKING AHEAD MAKES IT POSSIBLE
INNOVATION IS THE ESSENCE

Innovation inside: **Grundfos new CR**

Grundfos engineers gave our CR pumps a makeover:

- **Four new CR pumps** make it easier for you to find the right pump size
- **A redesigned cartridge seal** integrates seal components into a single unit that's easy to replace
- **Hard-wearing materials** prolong the life of the seal and the pump itself
- **Our new LiqTec™ dry-run detector** shuts down the pump before damage occurs
- **Increased reliability and operating economy** give you more peace of mind

We're proud to introduce a new generation of our pioneering CR pumps you and your customers will appreciate.



L-CR-SL-002 | 10/01
PRINTED IN USA

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GRUNDFOS®

GRUNDFOS **INSTRUCTIONS**
Installation and Operation

CR, CRI, CRX, CRN, CRT

Vertical Multistage Centrifugal Pumps

Please leave these instructions with the pump for future reference

BE > THINK > INNOVATE >

GRUNDFOS

SAFETY WARNING

Electrical Work

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Shock Hazard

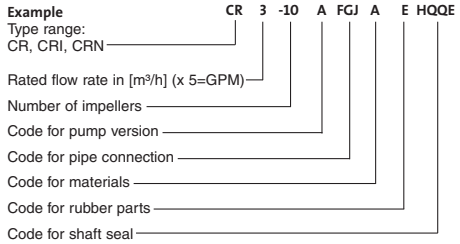
A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump to the power supply's grounding terminal is required for safe installation and operation.

In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.

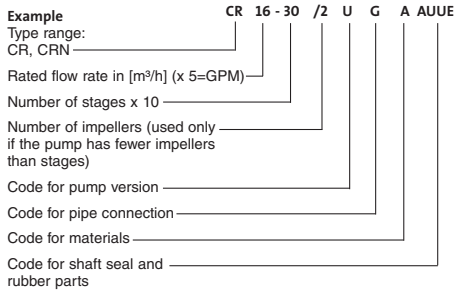
Nameplate Data

Type key

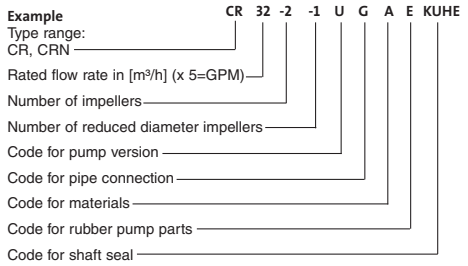
CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20

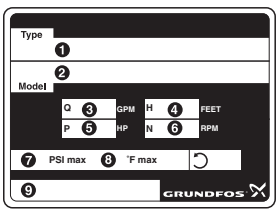


CR, CRX, CRN 8 and 16



CR, CRN 32, 45, 64, AND 90





1. Type designation
2. Model, material number, production code
3. Gallons per minute at rated RPM
4. Head in feet at nameplate flow
5. Pump horsepower
6. Rated RPM
7. Maximum PSI
8. Maximum fluid temperature
9. Production country

Codes

Example U FGJ A E HQQE

Pump version

A	*Basic version pump
U	*NEMA version pump
B	Oversize motor, one flange size bigger
F	CR pump for high temperatures (Cool-Top™)
H	Horizontal version
HS	High pressure pump with over-synchronous speed and reversed direction of rotation
I	Different pressure rating
K	Low NPSH
M	Magnetic drive
P	Undersize motor
R	Horizontal version with bearing bracket
SF	High pressure pump with reversed chamber stack and direction of rotation
T	Oversize motor, two flange sizes bigger
X	**Special version

Pipe connection

A	Oval flange
B	NPT thread
C	Clamp coupling
CA	FlexiClamp
CX	TriClamp
F	DIN flange
G	ANSI flange
J	JIS flange
N	Changed diameter of ports
O	Externally threaded, union
P	PJE coupling
X	Special version

Materials

A	Basic version
D	Carbon-graphite filled PTFE (bearings)
G	Stainless steel parts of 316 SS
GI	Base plate and flanges of 316 SS
I	Stainless steel parts of 304 SS
II	Base plate and flange of 304 SS
K	Bronze (bearings)
S	SiC bearing ring + PTFE neck ring (only CR, CRN 32 to 90)
T	Titanium
X	Special version

Code for rubber parts

E	EPDM
F	FXM (Flouraz®)
K	FFKM (Kalrez®)
V	FKM (Viton®)

Shaft seal H Q Q E

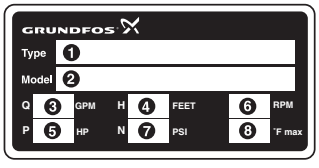
A	O-ring seal with fixed driver
B	Rubber bellows seal
D	O-ring seal, balanced
E	Cartridge seal with O-ring
H	Balanced cartridge seal with O-ring
K	Cartridge shaft seal with metal bellows
O	Double seal, back to back
P	Double seal, tandem
R	O-ring seal with reduced face
X	Special version

B	Carbon, synthetic resin-impregnated
H	Cemented tungsten carbide, embedded hybrid
Q	Silicon carbide
U	Cemented tungsten carbide

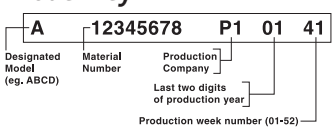
E	EPDM
F	FXM (Flouraz®)
K	FFKM (Kalrez®)
V	FKM (Viton®)

* In August 2003 the NEMA pump code was discontinued for all material numbers created by GRUNDFOS manufacturing companies in North America. The NEMA version pump code will still remain in effect for existing material numbers. NEMA version pumps built in North America after this change will have either an A or U as the pump version code depending on the date the material number was created.

** If a pump incorporates more than two pump versions, the code for the pump version is X. X also indicates special pump versions not listed above.



Model Key



Pre-installation Checklist

1. Confirm you have the right pump

Read the pump nameplate to make sure it is the one you ordered.

CR	—	Centrifugal pump with standard cast iron and 304 stainless steel construction
CRI or CRX	—	Centrifugal pump; all parts in contact with water are 304 stainless steel construction
CRN	—	Centrifugal pump; all parts in contact with water are 316 stainless steel construction
CRT	—	Centrifugal pump; all parts in contact with water are titanium construction
CRE	—	Centrifugal pump with a Grundfos MLE VFD motor attached

2. Check the condition of the pump

The shipping carton your pump came in is specially designed around your pump during production to prevent damage. As a precaution, the pump should remain in the carton until you are ready to install it. Examine the pump for any damage that may have occurred during shipping. Examine any other parts of the shipment as well for any visible damage.

If the pump is shipped as a complete unit (motor attached to pump end), the position of the coupling (that connects the pump shaft to the motor shaft) is set at factory specifications. No adjustment is required. If the unit is delivered as a pump end only, follow the adjustment procedures on pages 10-11.

Pump without Motor (CR(I)(N) 1s, 1, 3, 5, 10, 15, and 20 Only): If you purchased a pump without a motor, the shaft seal has been set by the factory. Do not loosen the three set screws on the shaft seal when attaching the motor.

Pump without Motor (CR(N) 32, 45, 64 & 90 Only): If you purchased a pump without a motor, you must install the seal. The seal is protected in its own sub boxing within the pump packaging crate. To protect the shaft and bearings during shipment, a shaft holder protective device is used. This device must be removed prior to installation of the seal. Read the seal installation instructions which are included in the pump package.

3. Verify electrical requirements

Verification of the electrical supply should be made to be certain the voltage, phase and frequency match that of the pump motor. The proper operating voltage and other electrical information can be found on the motor nameplate. These motors are designed to run on ±10% of the nameplate-rated voltage. For dual-voltage motors, the motor should be internally connected to operate on the voltage closest to the 10% rating, i.e., a 208 voltage motor wired per the 208 volt connection diagram. The wiring connection diagram can be found on either a plate attached to the motor or on a diagram inside the terminal box cover. If voltage variations are larger than ±10%, do not operate the pump.

4. Is the application correct for this pump?

Compare the pump's nameplate data or its performance curve with the application in which you plan to install it. Will it perform the way you want it to perform? Also, make sure the application falls within the following limits:

Type	Designed to pump...
CR	Hot and chilled water, boiler feed, condensate return, glycols and solar thermal fluids.
CRI/CRN/CRX	Deionized, demineralized and distilled water. Brackish water and other liquids unsuitable for contact with iron or copper alloys. (Consult manufacturer for specific liquid compatibilities.)
CRN-SF	High pressure washdown, reverse osmosis, or other high pressure applications.
CRT	Salt water, chloride based fluids and fluids approved for titanium.

Operating Conditions

Pump	Fluid Temperatures
CR(I)(N) 1s, 3, 5, 10, 15, and 20	-4 to +248°F (-20 to +120°C)
*CR(N) 32, 45, 64, and 90	-22 TO +248°F (-30 TO +120°C)
CR(N)(X)(T) 2, 4, 8, 16	-4 to +248°F (-20 to +120°C)
CRN-SF	-4 to +221°F (-15 to +105°C)
with Cool-Top™	up to +356°F (+180°C)

All motors are designed for continuous duty in +104°F (+40°C) ambient air conditions. For higher ambient temperature conditions consult Grundfos.

* xUBE Shaft Seals are recommended for temperatures above +200°F. Pumps with hybrid shaft seals can only operate up to +200°F (+90°C). Pumps with xUUE shaft seals can be operated down to -40°F (-40°C) (where "x" is the seal type).

Pre-installation Checklist (continued)

Minimum Inlet Pressures

All CR, CRI, CRX, CRN	NPSHR + 2 feet
CRN-SF	29 psi (2 bar)

Maximum Inlet Pressures

Pump Type	50 Hz Stages	60 Hz Stages	Max psi/bar
CR, CRI, CRN 1s	2 to 36	2 to 25	145 / 10
		27	217 / 15
CR, CRI, CRN 1	2 to 36	2 to 25	145 / 10
		27	217 / 15
CR, CRI, CRN 3	2 to 29	2 to 15	145 / 10
	31 to 36	17 to 25	217 / 15
CR, CRI, CRN 5	3 to 16	2 to 9	145 / 10
	18 to 36	10 to 24	217 / 15
CR, CRI, CRN 10	1 to 6	1 to 5	116 / 8
	7 to 22	6 to 18	145 / 10
CR, CRI, CRN 15	1 to 3	1 to 2	116 / 8
	4 to 17	3 to 12	145 / 10
CR, CRI, CRN 20	1 to 3	1	116 / 8
	4 to 17	2 to 10	145 / 10
CR, CRN 32	1-1 to 4	1-1 to 2	58 / 4
	5-2 to 10	3-2 to 6	145 / 10
	11 to 14	7-2 to 11-2	217 / 15
CR, CRN 45	1-1 to 2	1-1 to 1	58 / 4
	3-2 to 5	2-2 to 3	145 / 10
	6-2 to 13-2	4-2 to 8-1	217 / 15
CR, CRN 64	1-1 to 2-2	1-1	58 / 4
	2-1 to 4-2	1 to 2-1	145 / 10
	4-1 to 8-1	2 to 5-2	217 / 15
CR, CRN 90	1-1 to 1		58 / 4
	2-2 to 3-2	1-1 to 1	145 / 10
	3 to 6	2-2 to 4-1	217 / 15
CRT 2	2 to 11	2 to 6	145 / 10
	13 to 26	7 to 18	217 / 15
CRT 4	1 to 12	1 to 7	145 / 10
	14 to 22	8 to 16	217 / 15
CRT 8	1 to 20	1 to 16	145 / 10
CRT 16	2 to 16	2 to 10	145 / 10
CR, CRX, CRN 8	1 to 6	1 to 4	87 / 6
	7 to 20	5 to 16	145 / 10
CR, CRX, CRN 16	2 to 3	2 to 3	87 / 6
	4 to 16	4 to 10	145 / 10
CRN-SF	all	all	72 / 5*
			362 / 25**

* while pump is off or during start-up

** during operation

Maximum Operating Pressures

at 250° F (194° F for CRN-SF)

Pump type/ connection	50 Hz Stages	60 Hz Stages	Max psi/bar
CR, CRI, CRN 1s			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 1			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 3			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 5			
Oval flange	1 to 22	1 to 16	232 / 16
FGJ, PJE	1 to 36	1 to 24	362 / 25
CR, CRI, CRN 10			
Oval flange		1 to 10	145 / 10
Oval flange	1 to 16		232 / 16
FGJ, GJ, PJE	1 to 16	1 to 10	232 / 16
FGJ, GJ, PJE	17 to 22	12 to 17	362 / 25
CR, CRI, CRN 15			
Oval flange	1 to 7	1 to 5	145 / 10
FGJ, GJ, PJE	1 to 10	1 to 8	232 / 16
FGJ, GJ, PJE	12 to 17	9 to 12	362 / 25
CR, CRI, CRN 20			
Oval flange	1 to 7	1 to 5	145 / 10
FGJ, GJ, PJE	1 to 10	1 to 7	232 / 16
FGJ, GJ, PJE	12 to 17	8 to 10	362 / 25
CR, CRN 32	1-1 to 7	1-1 to 5	232 / 16
	8-2 to 12	6-2 to 8	362 / 25
	13-2 to 14	9-2 to 11-2	580 / 40
CR, CRN 45	1-1 to 5	1-1 to 4-2	232 / 16
	6-2 to 9	4-1 to 6	362 / 25
	10-2 to 13-2	7-2 to 8-1	580 / 40
CR, CRN 64	1-1 to 5	1-1 to 3	232 / 16
	6-2 to 8-1	4-2 to 5-2	362 / 25
CR, CRN 90	1-1 to 4	1-1 to 3	232 / 16
	5-2 to 6	4-2 to 4-1	362 / 25
CRT 2	2 to 26	2 to 18	305 / 21
CRT 4	1 to 22	1 to 16	305 / 21
CR, CRX, CRN, CRT 8	1 to 12	1 to 8	232 / 16
	14 to 20	10 to 16	362 / 25
CR, CRX, CRN, CRT 16	1 to 8	1 to 8	232 / 16
	10 to 16	10 to 12	362 / 25

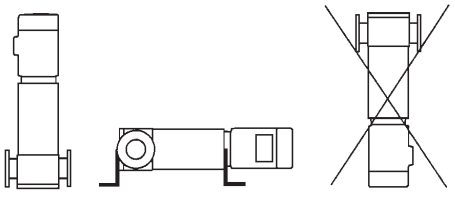
Consult Grundfos for other working conditions.

Select pump location

The pump should be located in a dry, well-ventilated area which is not subject to freezing or extreme variation in temperature. Care must be taken to ensure the pump is mounted at least 6 inches (150 mm) clear of any obstruction or hot surfaces. The motor requires an adequate air supply to prevent overheating and adequate vertical space to remove the motor for repair. For open systems requiring suction lift the pump should be located as close to the water source as possible to reduce piping losses.

Foundation

Concrete or similar foundation material should be used to provide a secure, stable mounting base for the pump. Bolt hole center line dimensions for the various pump types are given in Figure 1. Secure the pump to the foundation using all four bolts and shim pump base to assure the pump is vertical and all four pads on the base are properly supported. Uneven surfaces can result in pump base breakage when mounting bolts are tightened.



The pump can be installed vertically or horizontally (see drawing at right). Ensure that an adequate supply of cool air reaches the motor cooling fan. The motor must never fall below the horizontal plane.

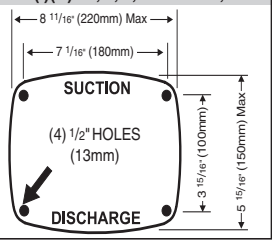
Arrows on the pump base show the direction of flow of liquid through the pump.

To minimize possible noise from the pump, it is advisable to fit expansion joints on either side of the pump and anti-vibration mountings between the foundation and the pump.

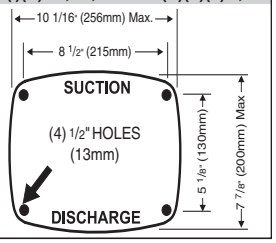
Isolating valves should be fitted either side of the pump to avoid draining the system if the pump needs to be cleaned, repaired or replaced.

Figure 1: Bolt Hole Centers

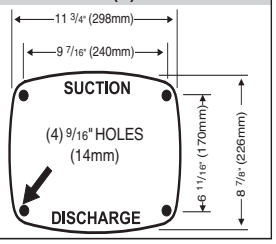
CR(I)(N) 1s, 1, 3, 5 & CRT 2, 4



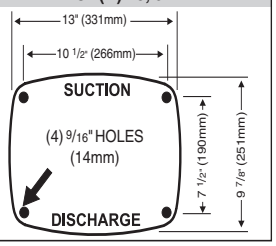
CR(I)(N) 10, 15, 20 & CR(N)(X)(T) 8, 16



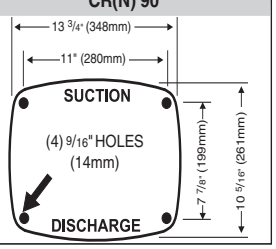
CR(N) 32



CR(N) 45, 64



CR(N) 90



Pipework

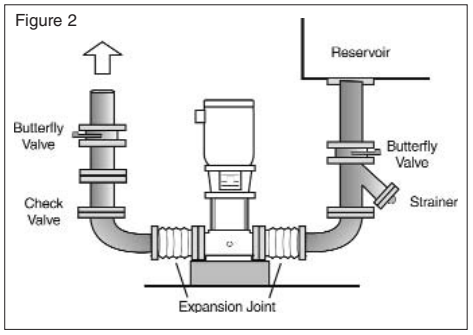
NOTE: The CR(N) pumps are shipped with covered suction and discharge. The covers must be removed before the final pipe flange to pump connections are made.

Suction pipe

The suction pipe should be adequately sized and run as straight and short as possible to keep friction losses to a minimum (minimum of four pipe diameters straight run prior to the suction flange). Avoid using unnecessary fittings, valves or accessory items. Butterfly or gate valves should only be used in the suction line when it is necessary to isolate a pump because of a flooded suction condition. This would occur if the water source is above the pump. See Figures 2 and 3. Flush piping prior to pump installation to remove loose debris.

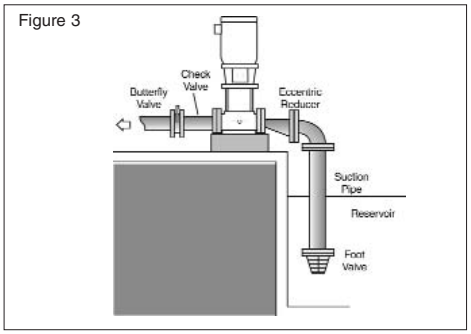
Flooded Suction

Figure 2



Suction Lift*

Figure 3



* CRN-SF pumps cannot be used for suction lift. The suction pipe should have a fitting on it for priming.

Minimum suction pipe sizes

The following recommended suction pipe sizes are the smallest sizes which should be used with any specific CR pump type. The suction pipe size should be verified with each installation to ensure good pipe practices are being observed and excess friction losses are not encountered. High temperatures may require larger diameter pipes to reduce friction and improve NPHSA.

CR(I)(N) 1s, 1, 3, CRT 2	1"	Nominal diameter sch 40 pipe
CR(I)(N) 5, CRT 4	1 1/4"	Nominal diameter sch 40 pipe
CR(I)(N)(X) 10, 15, 20, 8, 16	2"	Nominal diameter sch 40 pipe
CR(N) 32	2 1/2"	Nominal diameter sch 40 pipe
CR(N) 45	3"	Nominal diameter sch 40 pipe
CR(N) 64	4"	Nominal diameter sch 40 pipe
CR(N) 90	4"	Nominal diameter sch 40 pipe

Discharge piping

It is suggested that a check valve and isolation valve be installed in the discharge pipe. Pipe, valves and fittings should be at least the same diameter as the discharge pipe or sized in accordance with good piping practices to reduce excessive fluid velocities and pipe friction losses. **Pipe, valves and fittings must have a pressure rating equal to or greater than the maximum system pressure.** Before the pump is installed it is recommended that the discharge piping be pressure checked to at least the maximum pressure the pump is capable of generating or as required by codes or local regulations.

Whenever possible, avoid high pressure loss fittings, such as elbows or branch tees directly on either side of the pump. The piping should be adequately supported to reduce thermal and mechanical stresses on the pump. Good installation practice recommends the system be thoroughly cleaned and flushed of all foreign materials and sediment prior to pump installation. Furthermore, the pump should never be installed at the lowest point of the system due to the natural accumulation of dirt and sediment. If there is excessive sediment or suspended particles present, it is advised a strainer or filter be used. Grundfos recommends that pressure gauges be installed on inlet and discharge flanges or in pipes to check pump and system performance.

NOTE: To avoid problems with waterhammer, fast closing valves must not be used in CRN-SF applications.

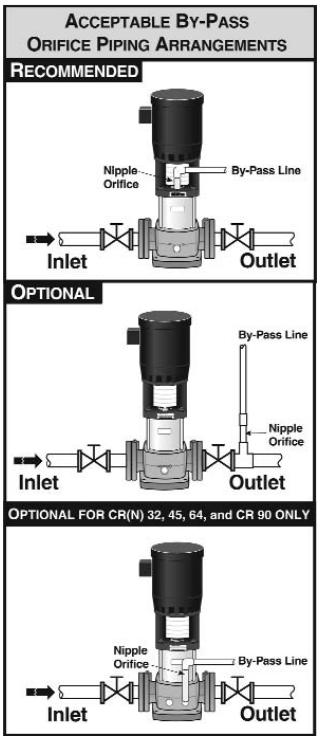


Table A

Minimum Continuous Duty Flow Rates for CR(I)(X)(N)(T)

Pump Type	Min. Flow in GPM at Liquid Temperature min°F to 176°F min°C to 80°C	at 210°F at 99°C	at 248°F at 120°C	Cool-Top™ at 356°F at 180°C
CR, CRI, CRN 1s	0.5	0.7	1.2	1.2*
CR, CRI, CRN 1	0.9	1.3	2.3	2.3*
CR, CRI, CRN 3	1.6	2.4	4.0	4.0*
CR, CRI, CRN 5	3.0	4.5	7.5	7.5*
CR, CRI, CRN 10	5.5	8.3	14	14*
CR, CRI, CRN 15	9.5	14	24	24*
CR, CRI, CRN 20	11	17	28	28*
CR, CRN 32	14	21	35	35*
CR, CRN 45	22	33	55	55*
CR, CRN 64	34	51	85	85*
CR, CRN 90	44	66	110	110*
CRT 2	1.3	2.0	3.3	N/A
CRT 4	3.0	4.5	7.5	N/A
CR, CRX, CRN, CRT 8	4.0	6.0	10	10*
CR, CRX, CRN, CRT 16	8.0	12	20	20*

*Grundfos Cool-Top is only available in the following pump types.

Pump Type	CR 1s	CR 1	CR 3	CR 5	CR 10	CR 15	CR 20	CR 32	CR 45	CR 64	CR 90	CR 8	CR 16
Standard (CR)								•	•	•	•		
I Version (CRI)	•	•	•	•	•	•	•						
N Version (CRN)	•	•	•	•	•	•	•	•	•	•	•	•*	•*

* CRN 8 and 16 are only available in CRN-S. A CRN-S is a CRN pump without staybolts. All rubber parts are FXM.

Check valves

A check valve may be required on the discharge side of the pump to prevent the pump's inlet pressure from being exceeded. For example, if a pump with no check valve is stopped because there is no demand on the system (all valves are closed), the high system pressure on the discharge side of the pump will "find" its way back to the inlet of the pump. If the system pressure is greater than the pump's maximum inlet pressure rating, the limits of the pump will be exceeded and a check valve needs to be fitted on the discharge side of the pump to prevent this condition. **This is especially critical for CRN-SF applications because of the very high discharge pressures involved. As a result, most CRN-SF installations require a check valve on the discharge piping.**

Bypass

A bypass should be installed in the discharge pipe if there is any possibility the pump may operate against a closed valve in the discharge line. Flow through the pump is required to ensure adequate cooling and lubrication of the pump is maintained. See Table A for minimum flow rates. Elbows should be a minimum of 12" from the orifice discharge to prevent erosion.

Temperature rise

It may sometimes be necessary to stop the flow through a pump during operation. At shut-off, the power to the pump is transferred to the pumped liquid as head, causing a temperature rise in the liquid. The result is risk of excess heating of and consequent damage to the pump. The risk depends on the temperature of the pumped liquid and for how long the pump is operating without flow. (See temperature rise chart.)

Pump Type	Time for Temperature Rise of 18° F (10°C) Seconds	Minutes
CR 1s, 1, 3	210	3.5
CR 5	240	4.0
CR 10	210	3.5
CR 15	150	2.5
CR 20	120	2.0
CR 32, 45, 64, 90	60	1.0

Conditions/Reservations

The listed times are subject to the following conditions/reservations:

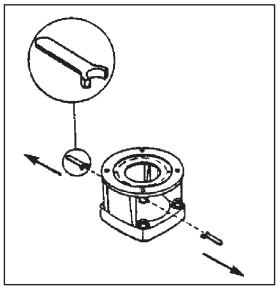
- No exchange of heat with the surroundings.
- The pumped liquid is water with a specific heat of 1.0 $\frac{\text{Btu}}{\text{lb.°F}}$ (4.18 $\frac{\text{kJ}}{\text{kg°C}}$).
- Pump parts (chambers, impellers and shaft) have the same thermal capacity as water.
- The water in the base and the pump head is not included.

These reservations should give sufficient safety margin against excessive temperature rise. The maximum temperature must not exceeed the pump maximum rating.

For Pump Ends With Bellows Seals Only (CR 2, 4, 8, 16)

Remove shaft seal protectors before installing motor (see diagram at below).

1. Remove coupling guards.
2. Remove coupling halves.
3. Remove shaft seal protectors.
4. Follow motor replacement instructions on page 10.



Electrical

WARNING

THE SAFE OPERATION OF THIS PUMP REQUIRES THAT IT BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND LOCAL GOVERNING CODES OR REGULATIONS. CONNECT THE GROUND WIRE TO THE GROUNDING SCREW IN THE TERMINAL BOX AND THEN TO THE ACCEPTABLE GROUNDING POINT.

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Motor

Grundfos CR pumps are supplied with heavy-duty 2-pole (3600 RPM nominal), ODP or TEFC, NEMA C frame motors selected to our rigid specifications. Motors with other enclosure types and for other voltages and frequencies are available on a special-order basis. CRN-SF pumps are supplied with an IEC (metric) type motor with a reverse thrust bearing. If you are replacing the pumping unit, but are using a motor previously used on another CR pump, be sure to read the "Motor Replacement" section on page 10 for proper adjustment of the coupling height.

Position of Terminal Box

The motor terminal box can be turned to any of four positions in 90° steps. To rotate the terminal box, remove the four bolts securing the motor to the pump but do not remove the shaft coupling; turn the motor to the desired location; replace and securely tighten the four bolts. See Figure 4.

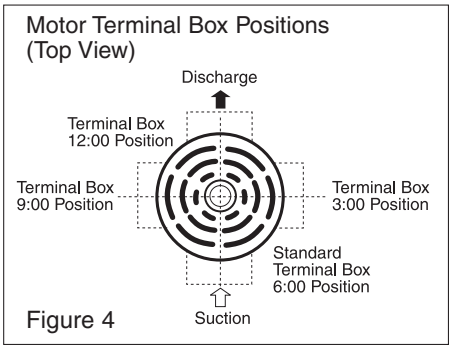


Figure 4

Field Wiring

Wire sizes should be based on the current carrying properties of a conductor as required by the latest edition of the National Electrical Code or local regulations. Direct on line (D.O.L.) starting is approved due to the extremely fast run-up time of the motor and the low moment of inertia of pump and motor. If D.O.L. starting is not acceptable and reduced starting current is required, an auto transformer, resistant starter or soft start should be used. It is suggested that a fused disconnect be used for each pump where service and standby pumps are installed.

Motor Protection

1. **Single-Phase Motors:**

   With the exception of 7 1/2 and 10 HP motors which require external protection, single-phase CR pumps are equipped with multi-voltage, squirrel-cage induction motors with built-in thermal protection.

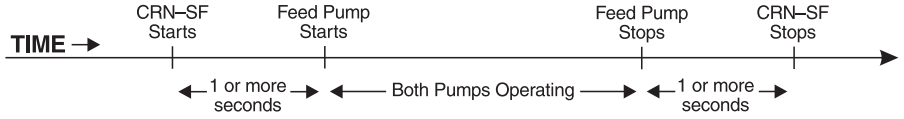
2. **Three-Phase Motors**

   CR pumps with three-phase motors must be used with the proper size and type of motor-starter to ensure the motor is protected against damage from low voltage, phase failure, current imbalance and overloads. A properly sized starter with manual reset and ambient-compensated extra quick trip in all three legs should be used. The overload should be sized and adjusted to the full-load current rating of the motor. Under no circumstances should the overloads be set to a higher value than the full load current shown on the motor nameplate. This will void the warranty. Overloads for auto transformers and resistant starters should be sized in accordance with the recommendations of the manufacturer. Three phase MLE motors (CRE-Pumps) require only fuses as a circuit breaker. They do not require a motor starter. Check for phase imbalance (worksheet is provided on page 15).

   NOTE: Standard allowable phase imbalance difference is 5%.

3. **CRN-SF**

   The CRN-SF is typically operated in series with a feed pump. Because the maximum allowable inlet pressure of the CRN-SF increases from 73 psi (when pump is off and during start-up) to 365 psi (during operation), a control device must be used to start the CRN-SF pump one second before the feed pump starts. Similarly, the CRN-SF must stop one second after the feed pump stops.



Starting the Pump the First Time

Figure 5a

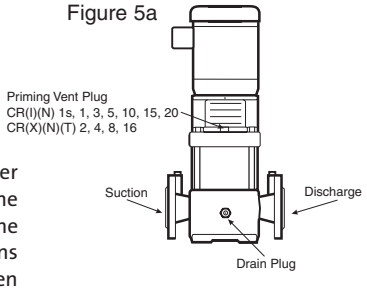
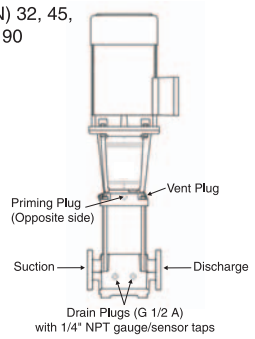


Figure 5b

CR(N) 32, 45, 64 & 90



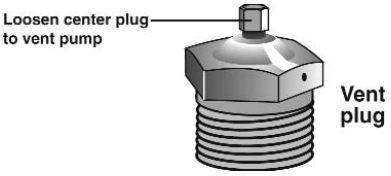
Priming

To prime the pump in a closed system or an open system where the water source is above the pump, close the pump isolation valve(s) and open the priming plug on the pump head. See Figures 5A and 5B. Gradually open the isolation valve in the suction line until a steady stream of airless water runs out the priming port. Close the plug and securely tighten. Completely open the isolation valves.

In open systems where the water level is below the pump inlet, the suction pipe and pump must be filled and vented of air before starting the pump. Close the discharge isolation valve and remove the priming plug. Pour water through the priming hole until the suction pipe and pump are completely filled with water. If the suction pipe does not slope downward from the pump toward the water level, the air must be purged while being filled. Replace the priming plug and securely tighten.

1. Switch power off.
2. Check to make sure the pump has been filled and vented.
3. Remove the coupling guard and rotate the pump shaft by hand to be certain it turns freely.
4. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
5. Switch the power on and observe the direction of rotation. When viewed from the top, the pump should rotate counter-clockwise (clockwise for CRN-SF).
6. To reverse the direction of rotation, first switch OFF the supply power.
7. On three-phase motors, interchange any two power leads at the load side of the starter. On single-phase motors, see connection diagram on nameplate. Change wiring as required.
8. Switch on the power and again check for proper motor rotation. Once rotation has been verified, switch off power again. Do not attempt to reinstall the coupling guards with the motor energized. Replace the coupling guard if the rotation is correct. After guards are in place the power can be reapplied.

NOTE: Motors should not be run unloaded or uncoupled from the pump at any time; damage to the motor bearings will occur.



REMINDER: Do not start the pump before priming or venting the pump. Never operate the pump dry.

Operating Parameters

CR multi-stage centrifugal pumps installed in accordance with these instructions and sized for correct performance will operate efficiently and provide years of service. The pumps are water-lubricated and do not require any external lubrication or inspection. The motors will require periodic lubrication as noted in the following Maintenance Section.

Under no circumstances should the pump be operated for any prolonged periods of time without flow through the pump. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed to allow sufficient water to circulate through the pump to provide adequate cooling and lubricaton of the pump bearings and seals.

Pump cycling

Pump cycling should be checked to ensure the pump is not starting more than:

20 times per hour on 1/3 to 5 HP models
15 times per hour on 7 1/2 to 15 HP models
10 times per hour on 20 to 60 HP models

Rapid cycling is a major cause of premature motor failure due to increased heat build-up in the motor. If necessary, adjust controls to reduce the frequency of starts and stops.

Boiler-feed installations

If the pump is being used as a boiler-feed pump, make sure the pump is capable of supplying sufficient water throughout its entire evaporation and pressure ranges. Where modulating control valves are used, a bypass around the pump must be installed to ensure pump lubrication (see "Minimum Continuous Duty Flow Rates").

Freeze Protection

If the pump is installed in an area where freezing could occur, the pump and system should be drained during freezing temperatures to avoid damage. To drain the pump, close the isolation valves, remove the priming plug and drain plug at the base of the pump. Do not replace the plugs until the pump is to be used again. Always replace the drain plug with the original or exact replacement. **Do not** replace with a standard plug. Internal recirculation will occur, reducing the output pressure and flow.

Motor Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every three months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

WARNING:

DO NOT TOUCH ELECTRICAL CONNECTIONS BEFORE YOU FIRST ENSURE THAT POWER HAS BEEN DISCONNECTED. ELECTRICAL SHOCK CAN CAUSE SERIOUS OR FATAL INJURY. ONLY QUALIFED PERSONNEL SHOULD ATTEMPT INSTALLATION, OPERATION, AND MAINTENANCE OF THIS EQUIPMENT.

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper, pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use an Ohmmeter ("Megger") periodically to ensure that the integrity of the winding insulation has been maintained. Record the Ohmmeter readings. Immediately investigate any significant drop in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

Motor Lubrication

Electric motors are pre-lubricated at the factory and do not require additional lubrication at start-up. Motors without external grease fittings have sealed bearings that cannot be re-lubricated. Motors with grease fittings should **only** be lubricated with approved types of grease. Do not **over-grease** the bearings. Over greasing will cause increased bearing heat and can result in bearing/motor failure. Do not mix petroleum grease and silicon grease in motor bearings.

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearings, the speed at which the bearings operate and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program. It should also be noted that pumps with more stages, pumps running to the left of the performance curve, certain pump ranges may have higher thrust loads. Pumps with high thrust loads should be greased according to the next service interval level.

Severity of Service	Ambient Temperature (Maximum)	Environment	Approved Types of Grease
Standard	+104°F (+40°C)	Clean, little corrosion	See motor nameplate for grease type or compatible equivalent type of grease
Severe	+122°F (+50°C)	Moderate dirt, corrosion	
Extreme	>+122°F (+50°C) or Class H insulation	Severe dirt, abrasive dust, corrosion	

If pump is fitted with a bearing flange that requires grease, see the stickers on either the bearing flange or coupling guards for proper grease type and greasing schedule.

Motor Lubrication Schedule

NEMA/(IEC) Frame Size	Standard Service Interval	Severe Service Interval	Extreme Service Interval	Weight of Grease to Add Oz./(Grams)	Volume of Grease to Add In^3/(Teaspoons)
Up through 210 (132)	5500 hrs.	2750 hrs.	550 hrs.	0.30 (8.4)	0.6 (2)
Over 210 through 280 (180)	3600 hrs.	1800 hrs.	360 hrs.	0.61 (17.4)*	1.2 (3.9)*
Over 280 up through 360 (225)	2200 hrs.	1100 hrs.	220 hrs.	0.81 (23.1)*	1.5 (5.2)*
Over 360 (225)	2200 hrs.	1100 hrs.	220 hrs.	2.12 (60.0)*	4.1 (13.4)*

*The grease outlet plug **MUST** be removed before adding new grease.

Procedure

CAUTION:

TO AVOID DAMAGE TO MOTOR BEARINGS, GREASE MUST BE KEPT FREE OF DIRT. FOR AN EXTREMELY DIRTY ENVIRONMENT, CONTACT YOUR BALDOR DISTRIBUTOR OR AN AUTHORIZED BALDOR SERVICE CENTER FOR ADDITIONAL INFORMATION.

1. Clean all grease fittings. If the motor does not have grease fittings, the bearing is sealed and cannot be greased externally.
2. If the motor is equipped with a grease outlet plug, remove it. This will allow the old grease to be displaced by the new grease.
3. If the motor is stopped, add the recommended amount of grease. If the motor is to be greased while running, a slightly greater quantity of grease will have to be added.

   NOTE: If new grease does not appear at the shaft hole or grease outlet plug, the outlet passage may be blocked. At the next service interval the bearings must be repacked.

   Add grease SLOWLY until new grease appears at the shaft hole in the endplate or grease outlet plug. Never add more than 1-1/2 times the amount of grease shown in the lubrication schedule.
4. For motors equipped with a grease outlet plug, let the motor run for 20 minutes before replacing the plug.

Preventative Maintenance

At regular intervals depending on the conditions and time of operation, the following checks should be made:

1. Pump meets required performance and is operating smoothly and quietly.
2. There are no leaks, particularly at the shaft seal.
3. The motor is not overheating.
4. Remove and clean all strainers or filters in the system.
5. Verify the tripping of the motor overload protection.
6. Check the operation of all controls. Check unit control cycling twice and adjust, if necessary.
7. If the pump is not operated for unusually long periods, the unit should be maintained in accordance with these instructions. In addition, if the pump is not drained, the pump shaft should be manually rotated or run for short periods of time at monthly intervals.
8. To extend the pump life in severe duty applications, consider performing one of the following actions:
   - Drain the pump after each use.
   - Flush the pump , through system, with water or other fluid that is compatible with the pump materials and process liquid.
   - Disassemble the pump liquid components and thoroughly rinse or wash them with water or other fluid dthat is compatible with the pump materials and process liquid.

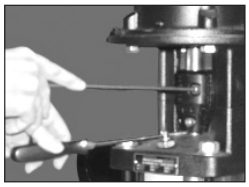
   If the pump fails to operate or there is a loss of performance, refer to the Troubleshooting Section on pages 13-14.

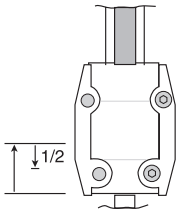
Motor Replacement

If the motor is damaged due to bearing failure, burning or electrical failure, the following instructions detail how to remove the motor for replacement. It must be emphasized that motors used on CR pumps are specifically selected to our rigid specifications. Replacement motors must be of the same frame size, should be equipped with the same or better bearings and have the same service factor. Failure to follow these recommendations may result in premature motor failure.

Figure 6

CR(X)(N)(T) 8, 16 & CRT 2, 4





- Note the clearance below the coupling
- Raise the coupling higher, as far as it will go.
- Lower it halfway back down (1/2 the distance you just raised it).
- Tighten screws (see torque specifications below)

Disassembly

1. Turn off and lock out power supply. The power supply wiring can not be safely disconnected from the motor wires.
2. Remove the coupling guards.
3. Using the proper metric Allen wrench, loosen the four cap screws in the coupling. Completely remove coupling halves. On CR1s-CR20, the shaft pin can be left in the pump shaft. CR(N)32, 45, 64 and 90 do not have a shaft pin.

   CR 1s, 1, 3, 5, 10, 15, and 20: do not loosen the three shaft seal securing allen screws.
4. With the correct size wrench, loosen and remove the four bolts which hold the motor to the pump end.
5. Lift the motor straight up until the shaft has cleared the motor stool.

Assembly

1. Remove key from motor shaft, if present, and discard.
2. Thoroughly clean the surfaces of the motor and pump end mounting flange. The motor and shaft must be clean of all oil/grease and other contaminants where the coupling attaches. Set the motor on the pump end.
3. Place the terminal box in the desired position by rotating the motor.
4. Insert the mounting bolts, then diagonally and evenly tighten. For 3/8" bolts, torque to 17 ft.-lbs., for 1/2" bolts torque to 30 ft.-lbs., and for 5/8" bolts torque to 59 ft.-lbs.
5. **CR 1s, 1, 3, and 5:**
   Insert shaft pin into shaft hole. Reinstall the coupling halves onto shaft and shaft pin. Reinstall the coupling screws and leave loose. Check that the gaps on either side of the coupling are even, and that the motor shaft keyway is centered in the coupling half, as shown in Figure 6a, page 11. Tighten the screws to the correct torque.

   CR 10, 15 and 20:

   Insert shaft pin into shaft hole. Insert plastic shaft seal spacer beneath shaft seal collar. Reinstall the coupling halves onto shaft and shaft pin. Reinstall the coupling screws and leave loose. Check that the gaps on either side of the coupling are even and that the motor shaft key way is centered in the coupling half, as shown in Figure 6a, page 11. Tighten the screws to the correct torque. Remove plastic shaft seal spacer and hang it on inside of coupling guard.

   CR 2, 4, 8 and 16:

   Reinstall coupling halves. Make sure the shaft pin is located in the pump shaft. Put the cap screws loosely back into the coupling halves. Using a large screwdriver, raise the pump shaft by placing the tip of the screwdriver under the coupling and carefully elevating the coupling to its highest point (see Figure 6). Note: the shaft can only be raised approximately 0.20 inches (5mm). Now lower the shaft halfway back down the distance you just raised it and tighten the coupling screws (finger tight) while keeping the coupling separation equal on both sides. When the screws are tight enough to keep the couplings in place, then torque the screws evenly in a criss-cross pattern.

CR(N) 32, 45, 64 & CR90:

Place the plastic adjustment fork under the cartridge seal collar (see Figure 7).

Fit the coupling on the shaft so that the top of the pump shaft is flush with the bottom of the clearance chamber in the coupling (see Figure 8).

Lubricate the coupling screws with an anti-seize and lubricating compound. Tighten the coupling screws (finger tight) while keeping the coupling separation equal on both sides and the motor shaft keyway centered in the coupling half as shown in Figure 6a. When the screws are tight enough to keep the couplings in place, then torque the screws evenly in a crisscross pattern.

Torque coupling screws to 62 ft.-lbs. Remove the adjustment fork from under the cartridge seal collar and replace it to the storage location (see Figure 9).

Torque Specifications CR(I)(N) 1s, 1, 3, 5, 10, 15, and 20 CR(N)(X)(T) 2, 4, 8, and 16	
Coupling Bolt Size	**Min. Torque Specifications**
M6	10 ft-lbs.
M8	23 ft-lbs.
M10	46 ft-lbs.

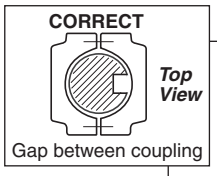
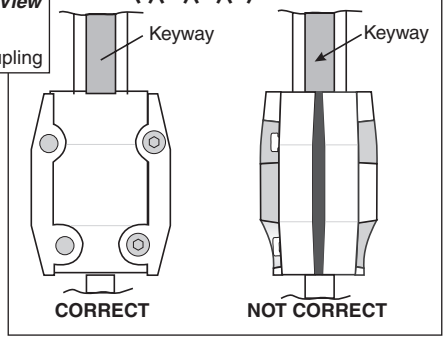
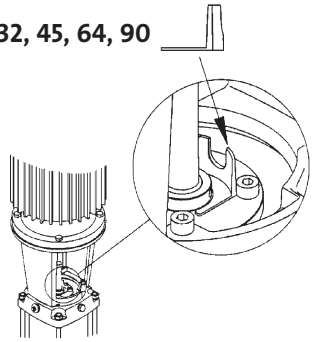


Figure 6a
All CR(I)(N)(X)(T)



6. Check to see that the gaps between the coupling halves are equal. Loosen and readjust, if necessary.
7. Be certain the pump shaft can be rotated by hand. If the shaft cannot be rotated or it binds, disassemble and check for misalignment.
8. Prime the pump.
9. Follow the wiring diagram on the motor label for the correct motor wiring combination which matches your supply voltage. Once this has been confirmed, reconnect the power supply wiring to the motor.
10. Check the direction of rotation, by bump-starting the motor. Rotation must be left to right (counter-clockwise) when looking directly at the coupling.
11. Shut off the power, then re-install the coupling guards. After the coupling guards have been installed the power can be turned back on.

Figure 7
CR(N) 32, 45, 64, 90

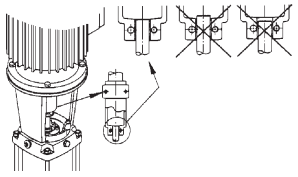


Parts List

For each CR pump model Grundfos offers an extensive **Parts List** and diagram of part used in that pump and is recommended to have on hand for future maintenance. In addition, the listings also provide information about prepackaged **Service Kits** for those pump components most likely to exhibit wear over time, as well as the complete Impeller Stack needed to replace the "guts" of each model. These Parts Lists are available separately from the Grundfos literature warehouse or as a set with extensive service instructions in the Grundfos CR **Service Manuals** (for a small charge).

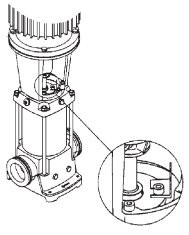
Left, prepackaged impeller stacks ready for immediate installation; right, prepackaged flange kits.

Figure 8



NOTE: To avoid damaging the coupling halves, ensure that no portion of the keyway on the motor shaft lies within the gap between the two coupling halves.

Figure 9



Spare Parts

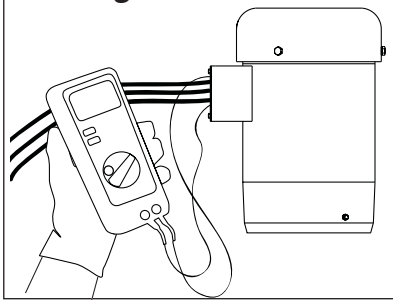
Grundfos offers an extensive list of spare parts. For a current list of these parts, refer to: "All Product Spare Parts/Service Kits" Price List, Form # L-SK-SL-002.

WARNING:

WHEN WORKING WITH ELECTRICAL CIRCUITS, USE CAUTION TO AVOID ELECTRICAL SHOCK. IT IS RECOMMENDED THAT RUBBER GLOVES AND BOOTS BE WORN, AND METAL TERMINAL BOXES AND MOTORS ARE GROUNDED BEFORE ANY WORK IS DONE. FOR YOUR PROTECTION, ALWAYS DISCONNECT THE PUMP FROM ITS POWER BEFORE HANDLING.

Preliminary tests

Supply voltage



How to measure

Use a voltmeter, (set to the proper scale) measure the voltage at the pump terminal box or starter.

On single-phase units, measure between power leads L1 and L2 (or L1 and N for 115 volt units). On three-phase units, measure between:

- Power leads L1 and L2
- Power leads L2 and L3
- Power leads L3 and L1

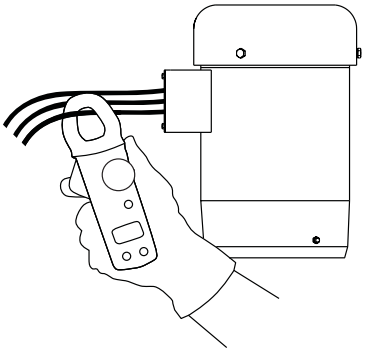
What it means

When the motor is under load, the voltage should be within ±10% of the nameplate voltage. Larger voltage variation may cause winding damage.

Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected.

If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

Current measurement



How to Measure

Use an ammeter, (set on the proper scale) to measure the current on each power lead at the terminal box or starter. See the motor nameplate for amp draw information.

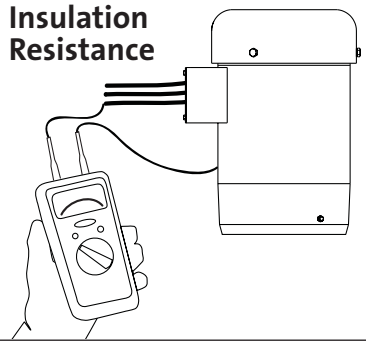
Current should be measured when the pump is operating at constant discharge pressure.

What it Means

If the amp draw exceeds the listed service factor amps (SFA) or if the current imbalance is greater than 5% between each leg on three-phase units, check the following:

1. Burned contacts on motor starter.
2. Loose terminals in starter or terminal box or possible wire defect.
3. Too high or too low supply voltage.
4. Motor windings are shorted or grounded. Check winding and insulation resistances.
5. Pump is damaged causing a motor overload.

Insulation Resistance



How to Measure

Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohm or mega ohm meter, set the scale selector to Rx 100K and zero adjust the meter.

Measure and record the resistance between each of the terminals and ground.

What it Means

Motors of all HP, voltage, phase and cycle duties have the same value of insulation resistance. Resistance values for new motors must exceed 1,000,000 ohms. If they do not, motor should be repaired or replaced.

Diagnosing specific problems

Problem	Possible cause	Remedy
The pump does not run	1. No power at motor.	Check for voltage at motor teminal box. If no voltage at motor, check feeder panel for tripped circuits and reset circuit.
	2. Fuses are blown or circuit breakers are tripped.	Turn off power and remove fuses. Check for continuity with ohmmeter. Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and wires must be checked.
	3. Motor starter overloads are burned or have tripped out.	Check for voltage on line and load side of starter. Replace burned heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil.
	4. Starter does not energize.	Energize control circuit and check for voltage at the holding coil. If no voltage, check control circuit fuses. If voltage, check holding coil for shorts. Replace bad coil.
	5. Defective controls.	Check all safety and pressure switches for operation. Inspect contacts in control devices. Replace worn or defective parts or controls.
	6. Motor is defective.	Turn off power and disconnect wiring. Measure the lead to lead resistances with ohmmeter (RX-1). Measure lead to ground values with ohmmeter (RX-100K). Record measured values. If an open or grounded winding is found, remove motor and repair or replace.
	7. Defective capacitor. (Single-phase motors)	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective.
	8. Pump is bound.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
The pump runs but at reduced capacity or does not deliver water	1. Wrong rotation	Check wiring for proper connections. Correct wiring.
	2. Pump is not primed or is airbound.	Turn pump off, close isolation valve(s), remove priming plug. Check fluid level. Refill the pump, replace plug and start the pump. Long suction lines must be filled before starting the pump.
	3. Strainers, check or foot valves are clogged.	Remove strainer, screen or valve and inspect. Clean and replace. Reprime pump.
	4. Suction lift too large.	Install compound pressure gauge at the suction side of the pump. Start pump and compare reading to performance data. Reduce suction lift by lowering pump, increase suction line size or removing high friction loss devices.
	5. Suction and/or discharge piping leaks.	Pump runs backwards when turned off. Air in suction pipe. Suction pipe, valves and fittings must be airtight. Repair any leaks and retighten all loose fittings.
	6. Pump worn.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shutoff. Convert measured pressure (in PSI) to head (in feet): (Measured PSI x 2.31 ft./PSI = _____ ft.). Refer to the specific pump curve for shutoff head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect.
	7. Pump impeller or guide vane is clogged.	Disassemble and inspect pump passageways. Remove any foreign materials found.

Diagnosing specific problems

Problem	Possible cause	Remedy
The pump runs but at reduced capacity or does not deliver water (continued)	8. Incorrect drain plug installed.	If the proper drain plug is replaced with a standard plug, water will recirculate internally. Replace with proper plug.
	9. Improper coupling setting.	Check/reset the coupling, see page 10.
Pump cycles too much	1. Pressure switch is not properly adjusted or is defective.	Check pressure setting on switch and operation. Check voltage across closed contacts. Readjust switch or replace if defective.
	2. Level control is not properly set or is defective.	Check setting and operation. Readjust setting (refer to level control manufacturer's data). Replace if defective.
	3. Insufficient air charging or leaking tank or piping.	Pump air into tank or diaphragm chamber. Check diaphragm for leak. Check tank and piping for leaks with soap and water solution. Check air to water volume. Repair as necessary.
	4. Tank is too small.	Check tank size and air volume in tank. Tank volume should be approximately 10 gallons for each gpm of pump capacity. The normal air volume is 2/3 of the total tank volume at the pump cut-in pressure. Replace tank with one of correct size.
	5. Pump is oversized.	Install pressure gauges on or near pump suction and discharge ports. Start and run pump under normal conditions, record gauge readings. Convert PSI to feet (Measured PSI x 2.31 ft./PSI = _____ ft.) Refer to the specific pump curve for that model, ensure that total head is sufficient to limit pump delivery within its design flow range. Throttle pump discharge flow if necessary.
Fuses blow or circuit breakers or overload relays trip	1. Low voltage.	Check voltage at starter panel and motor. If voltage varies more than ±10%, contact power company. Check wire sizing.
	2. Motor overloads are set too low.	Cycle pump and measure amperage. Increase heater size or adjust trip setting to a maximum of motor nameplate (full load) current.
	3. Three-phase current is imbalanced.	Check current draw on each lead to the motor. Must be within ±5%. If not, check motor and wiring. Rotating all leads may eliminate this problem.
	4. Motor is shorted or grounded.	Turn off power and disconnect wiring. Measure the lead-to-lead resistance with an ohmmeter (RX-1). Measure lead-to-ground values with an ohmmeter (RX-100K) or a megaohm meter. Record values. If an open or grounded winding is found, remove the motor, repair and/or replace.
	5. Wiring or connections are faulty.	Check proper wiring and loose terminals. Tighten loose terminals. Replace damaged wire.
	6. Pump is bound.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
	7. Defective capacitor (single-phase motors).	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective.
	8. Motor overloads at higher ambient temperature than motor.	Use a thermometer to check the ambient temperature near the overloads and motor. Record these values. If ambient temperature at motor is lower than at overloads, especially where temperature at overloads is above +104°F (+40°C), ambient-compensated heaters should replace standard heaters.

Three Phase Motors

Below is a worksheet for calculating current unbalance on a three-phase hookup and selecting the proper wiring. Use the calculations in the left-hand column as a guide.

EXPLANATION & EXAMPLES	
Here is an example of current readings at maximum pump loads on each leg of a three-wire hookup. You must make calculations for all three hookups. To begin, add up all three readings for hookup number 1, 2, and 3.	**Hookup 1** T1 = 51 Amps T2 = 46 Amps T3 = 53 Amps TOTAL = 150 Amps
Divide the total by three to obtain the average.	**Hookup 1** 50 Amps 3|150 Amps
Calculate the greatest current difference from the average.	**Hookup 1** 50 Amps – 46 Amps 4 Amps
Divide this difference by the average to obtain the percentage of unbalance. In this case, the current unblanace for hookup number 1 is 8%.	**Hookup 1** .08 or 8% 50| 4.00 Amps

FIGURE HERE		
Hookup 1 L_1 to T_1 = ____ Amps L_2 to T_2 = ____ Amps L_3 to T_3 = ____ Amps TOTAL = ____ Amps	**Hookup 2** L_1 to T_3 = ____ Amps L_2 to T_1 = ____ Amps L_3 to T_2 = ____ Amps TOTAL = ____ Amps	**Hookup 3** L_1 to T_2 = ____ Amps L_2 to T_3 = ____ Amps L_3 to T_1 = ____ Amps TOTAL = ____ Amps
Hookup 1 _____ Amps 3| _____ Amps	**Hookup 2** _____ Amps 3| _____ Amps	**Hookup 3** _____ Amps 3| _____ Amps
Hookup 1 ____ Amps – ____ Amps ____ Amps	**Hookup 2** ____ Amps – ____ Amps ____ Amps	**Hookup 3** ____ Amps – ____ Amps ____ Amps
Hookup 1 ____ or ____% ____|____ Amps	**Hookup 2** ____ or ____% ____|____ Amps	**Hookup 3** ____ or ____% ____|____ Amps

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L-CP-TL-003	Rev. 05/04
Printed in USA	

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GRUNDFOS

Ruben Moya <Moya.Ruben@epamail.epa.gov> September 5, 2012 5:31 AM
To: grish.org <curt@grish.org>
Re: Arkwood Site - Status Report

Hello Curt,

Sorry for the dates response...I've been out...
I know how you feel and will address this issue as soon as possible...

I'm gonna bring Gloria Moran in on this...need to get her take on this issue...so we can best see how to approach it.

ok?

Ruben

From: "grish.org" <curt@grish.org>
To: Ruben Moya/R6/USEPA/US@EPA
Cc: "grish.org" <curt@grish.org>
Date: 08/24/2012 11:49 AM
Subject: Re: Arkwood Site - Status Report

Hi Ruben, I know you're off; just wanted to write you while it was on my mind.

I have written before to Carlos and Don questioning the integrity of the water data used in McKesson's reports on Arkwood insofar as some of that data was created using a non-accredited lab in Missouri (MMET, Inc of Ozark Missouri, example attached).

I just spoke with Pat Shannon (>20 years at Missouri Department of Health and Senior Services, 573-751-3334) and Lori Dunmire (11 years at Missouri Department of Natural Resources' Environmental Services Program, 573-526-3326). Pat had heard of MMET, Inc (aka Middleton Microbiological & Environmental Testing) and said that lab never received microbiological laboratory certification by his agency during his time there. Lori had never heard of them and said they had not received chemical laboratory certification by her agency.

Would incorrect or unverified lab methodologies or sample handling (e.g. chain of custody) cause those data points to be thrown out and removed from any equation when determining averages, means, or trends in water quality related to Arkwood? Does anyone know what kind of facility MMET had for this work? Google shows the address of record (3889 N 20th St., Ozark, MO 65721 per Missouri Sec. of State) as rural residential (http://goo.gl/maps/R4YW9).

Has anyone ever put all the lab reports on water for Arkwood in a pile and checked them off against McKesson's data table, to verify the numbers got copied over correctly in the case of every data point in that table? I would do it myself, but the documents are difficult to dig out and assemble from my collection.

In the examples I have attached, two samples were taken and two different PCP numbers were derived by MMET for McKesson for that date (7/7/08); however, only the larger number was entered into McKesson's data table summarizing results. Is this evidence of a skew that pervaded the reporting?

I have never seen the evidence that the geology at Arkwood is simply "fractured karst," an underlying assumption upon which McKesson built part of its response. Is that geological assumption verified?

Thanks Ruben,

Curt
[attachment "Excerpt - Arkwood - 8-9-2012 - Responses to comments.pdf" deleted by Ruben Moya/R6/USEPA/US] [attachment "M12511_7-7-08 copy.pdf" deleted by Ruben Moya/R6/USEPA/US]
On Aug 23, 2012, at 1:34 PM, Ruben Moya wrote:

Curt,

Hope this helps...

Ruben

From: grish <curt@grish.org>
To: Ruben Moya/R6/USEPA/US@EPA
Cc: Gloria-Small Moran/R6/USEPA/US@EPA
Date: 08/23/2012 10:33 AM
Subject: Re: Arkwood Site - Status Report

Ok, thanks Ruben!
Curt

On Aug 23, 2012, at 6:56 AM, Ruben Moya <Moya.Ruben@epamail.epa.gov> wrote:

Curt,

I am also going to send you some copies of what was sent yesterday to McKesson in terms of shutting down the system and monitoring for a certain period of time...
I will send out today...its a total of three pieces of correspondence.
r,
Ruben

From: grish <curt@grish.org>
To: Gloria-Small Moran/R6/USEPA/US@EPA
Cc: Stephen Tzhone/R6/USEPA/US@EPA, Ruben Moya/R6/USEPA/US@EPA
Date: 08/21/2012 07:19 PM
Subject: Re: Arkwood Site - Status Report

That's great, Gloria; thank you!
Curt

On Aug 21, 2012, at 4:31 PM, Gloria-Small Moran <Moran.Gloria-Small@epamail.epa.gov> wrote:

Mr. Grisham:

Please see my letter below addressed to your father and sent via first class mail providing a status report concerning the Arkwood Inc. site.

Thank you,

Gloria Moran
Assistant Regional Counsel
Superfund Branch (6RC-S)
U.S.EPA, Region 6
1445 Ross Avenue
Dallas TX 75202-2733
214-665-3193
214-665-6460 (fax)
moran.gloria-small@epamail.epa.gov

<Letter to Bud Grisham Aug.21.12.pdf>

<GroundwaterRemediationDocument8222012.pdf><2012_08_15_Dye TracerTest_Critical Review_2012.pdf>
<Arkwood - 8-9-2012 - Responses to comments.pdf>